SCIENTIFIC AMERICAN

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Vol. XC.—No. 2.
ESTABLISHED 1845.

NEW YORK, JANUARY 9, 1904.

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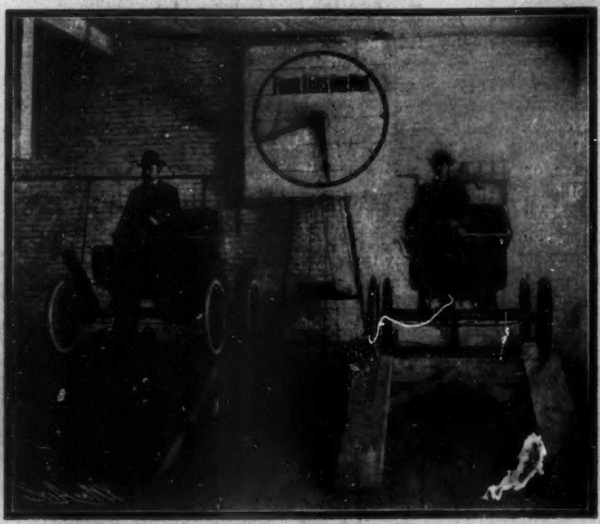
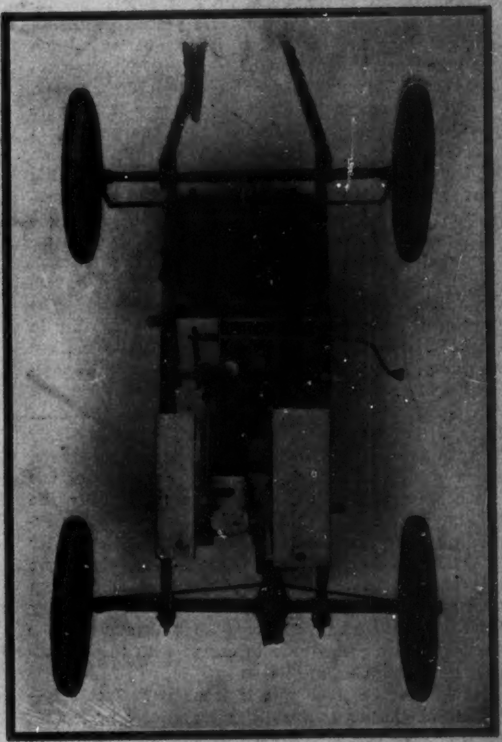


Freeing Up the Machines.

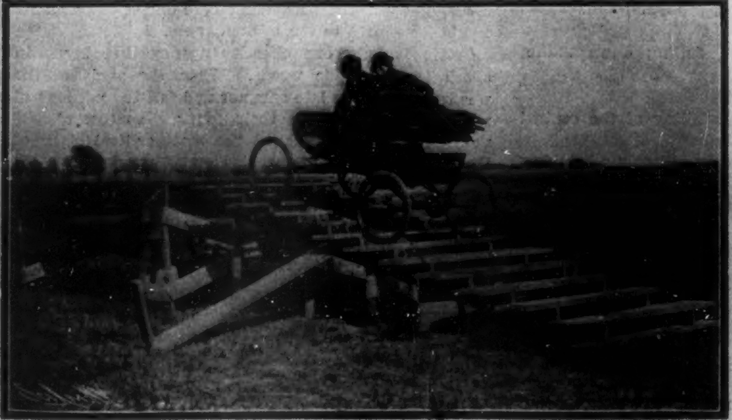
Assembling the Carriages.

Fitting Up Radiator Coils.

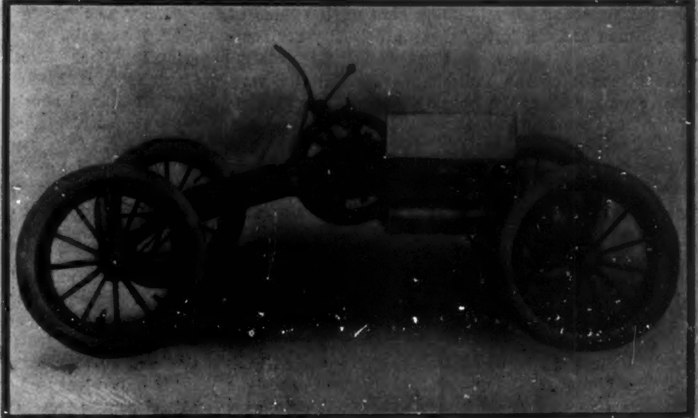
Fitting Up Wheels.



Plan View of the Oldsmobile.



A Difficult Feat.



Carriage Body Removed, Showing Running Gear and Motor.

HOW AMERICAN AUTOMOBILES ARE MADE IN LARGE QUANTITIES.—[See page 29.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845)................................$3.00 a year
Scientific American Supplement (Established 1876) .... 5.00 "
Scientific American Building Monthly (Established 1885)........ 2.50 "
Scientific American Export Edition (Established 1878)........... 3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JANUARY 9, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A CALL FOR STRONGER PASSENGER CARS.

The Pullman Company recently made the very significant statement that, during the year ending September 1, 1903, not a single passenger was killed or injured on a Pullman car in the State of New York. They also announced that although in the past three years the company had carried in all parts of the United States a total of 32,639,341 passengers, only six persons were killed (in two disastrous wrecks) and only four persons were seriously injured.

Compare these figures with the official statistics of railroad accidents in any given year, say for the year 1902, when 345 passengers were killed and 6,683 were injured. Of the thirty-two and a half million passengers that were carried in the three years in Pullman cars, only one in every three and a quarter million was killed or injured; but of the 640,000,000 passengers carried during the year 1902 in ordinary cars, over 7,000 passengers, or about one in every 92,000, were killed or injured. In other words, of two passengers who board a train together, he who enters a Pullman car has thirty-six chances of reaching the end of his journey in safety against one chance of his fellow passenger who enters an ordinary day coach.

Those of us who read between the lines in the accounts of railroad disasters, that appear with such shocking frequency in the columns of the morning papers, will not be at all surprised at these figures. The story of the smash-up, if it be a collision, may vary in details; but the general features will have a marked similarity. Thus the mail clerks will be killed outright, and the occupants of the smoker and first day coach, which in all probability will telescope into each other, will divide up the list of casualties pretty evenly between killed and injured; unless, indeed, a broken steam pipe is accountable for the parboiling of the whole mass of unfortunates; while incidentally the account will mention that the Pullman cars, after expending their momentum in crushing up the lighter first-class coaches, smokers, baggage cars, etc., came to rest, without any serious injury, and more often than not without even leaving the rails. Should they leave the rails and roll down an embankment, the passengers are pretty sure to escape with the conventional "bad shaking up."

Now, what do these results teach us? Just this—that if we cannot make railway travel safe by installing the very best signal systems, and by the careful selection of enginemen and train hands, switchmen, and operators; if we must forever go on having railway smashes, we can at least save the limb and the life of the passenger by building cars on the lines of the Pullman and rendering them practically accident-proof.

The strength of the Pullman car lies in its very massive underframe, the heavy steel angles and platings that are worked into the vestibule ends, and the massive vertical vestibule frames, which prevent the platforms from riding one upon another and shearing their way through the structure of the adjoining car. There is no question that it would be possible greatly to increase the safety of ordinary passenger travel, by constructing all railroad cars on the vestibule principle and building into the platforms that steel framing, which is largely answerable for the immunity from destruction in bad railroad wrecks of the present Pullman car. The railroad companies will naturally raise the objection that to give to all cars the strength of Pullman construction would so greatly increase the weight of trains, that the engines would be unable to cope with the service. But it is a fact that the strength and indestructibility of the Pullman car could be imparted to the ordinary first-class coach without any serious increase in the weight of the latter. The Pullman car is loaded down with a lot of unnecessary weight both in its structure and in its embellishments, which could be got rid of in the proposed type of car. A considerable saving of weight might be made by building the underframe, the sides below the sills, the platforms, and the vestibules, entirely of steel. This, indeed, has been done by the Illinois Central Railroad, to which too great credit cannot be given for the advance that has been made in its new steel passenger cars.

The steel passenger car is not by any means a novelty. In fact, between thirty and forty years ago, one of this type was constructed in this country and formed the subject of illustration in the columns of the Scientific American, while in Europe not only are the underframes of all cars built of steel, but there is a large number of freight cars of various types of metal construction that have proved their durable qualities by nearly half a century of service. In a railway collision it is always the weakest element that gives way. When telescoping occurs, it is the oldest car that is sliced in half by the platform of the adjoining car. With trains built entirely of steel cars, or cars with steel underframes, the injuries of a collision would be confined very largely to bruises and some broken limbs, due to the passengers being hurled violently forward under their own momentum. But the horrible dismemberment, the wholesale crushing out of life, now due to the telescoping of cars, would be of very rare occurrence. Indeed, with steel cars it is questionable whether telescoping would extend, even in the most severe collisions, much beyond the first eight or ten feet in the car.

In view of the shameful slaughter that has lately been going on upon our railroads in a series of accidents that is nothing short of a national disgrace, it becomes the duty of legislation to stipulate that for all new passenger cars, a certain minimum standard strength and excellence of construction shall be specified. By the mandate of the government we have the automatic coupler and the train brake; the time has now come for the government to demand for every passenger on the railroad the same immunity from maiming and death as is shown by the Pullman Company, in their statement of only ten persons killed or wounded out of thirty-two and a half million passengers.

CAN THE THEATER FIRE BE PREVENTED?

The panic and horror of collision at sea, with the terrible roar of the engulfing water, is only exceeded by that most pitiful of calamities—the theater fire. The very idea of the house of mirth being turned into a holocaust must appeal most strongly to even the hardest heart. The painful accident at the Iroquois Theater, Chicago, on the afternoon of December 30, when over 600 people were killed and some hundreds injured, is so very recent in the minds of all that it is unnecessary to dwell on the harrowing incidents of that awful scene. Suffice it to say that the fire is the third worst on record, the Ring Theater in Vienna, where 875 lives were lost, being the worst. The Brooklyn Theater fire in 1876, when 297 persons lost their lives, was brought home closer to us than any other.

The question of theater fires has received exhaustive treatment abroad. Out of 516 theater fires of which we have record, 460 were burned in the hundred years 1777 to 1877. These figures would now be considerably increased. The average life of an American theater at this period was only eleven to thirteen years, but fireproof construction has certainly doubled the life of the structures. Strange to say, the danger is only doubled during the performances, owing to the great watchfulness displayed while the audience is in its seats. Mr. W. Paul Gerhard, C. E., writing in the Scientific American Supplement, says:

"The lives of people in theaters, whether spectators, actors, musicians, chorus singers, ballet girls or stage hands, are, therefore, endangered:

"1. By smoke, fire gases, heat, asphyxia, exhaustion.

"2. By fire burns.

"3. By jams, knocking over, falling down stairs, trampling, crush.

"4. By direct shock or fright.

"5. By accidents, such as the falling of the central chandelier.

"The long list of theaters destroyed by fires breaking out during a performance, and the numerous instances of fires breaking out during these hours, but which are put out before spreading, are proof sufficient that the dangers spoken of are constantly threatening the theater-going public."

The third cause is quite as likely to result in death as the second, and seems wholly unnecessary if proper means are provided for a quick and orderly exit. Mr. Gerhard further says:

"If only plenty of exits are provided, so that, under all circumstances, the whole audience, even when frightened and suddenly thrown into a state of high mental excitement, can leave the building inside of two or three minutes, the fire-resisting qualities of the building are of less consequence, as regards the safety of the persons in the theater. In fact, a theater inferior in point of construction, but having exits as above described, would be safer than one built thoroughly fireproof, but otherwise not well arranged and not provided with sufficient stairs and exits, and where, therefore, in case of a false or real alarm of fire, or a panic from any cause, the people would be necessarily in grave peril."

In nearly all cities the regulation of the building of theaters is under the building department, but the fire department should have a voice as well. After construction, the theater is under the jurisdiction of the fire and police departments, who jointly look out for the safety of the public, the police at the front of the house and the firemen behind the curtain. We might give endless rules for the construction of safe playhouses, but our hand is stayed when we consider that apparently every safeguard known to modern science had been lavished on this theater, which had been opened less than five weeks. It is credibly stated that large sums had been spent to render the house immune from the very enemy which destroyed it. Still, the fact remains that one of the worst tragedies of modern times, involving a greater loss than the Spanish-American war, occurred in a "fireproof" building in broad daylight. Whatever may be the verdict which fixes responsibility, one thing is certain—the fire curtain must be so stiffened that no draught can belly it out so that it can bind or leave its groove. It must be arranged so that it can be tripped from the stage or the auditorium by purely mechanical means, very strongly and reliably constructed. The mechanism should be designed so that in case of any breakdown the curtain at once falls to the danger position. Possibly a steel girder spanning the proscenium and working vertically in well-oiled metal channels would be sufficient to carry a reinforced curtain, whose edges are anchored to the channels at regular intervals by steel guides. The fireproof wall should be extended up to meet the girder at the stage. Possibly two curtains would minimize the danger. Wood should be excluded absolutely from the stage, except where required by the scenery, and then it should be fireproofed. It is imperative that fireproof paint be used, and that all gauzes and scenes (drop and borders) be impregnated with chemicals. Asbestos can be freely used in properties, and wire rope should be substituted for ordinary ropes wherever possible. Accumulations of scenery should be avoided, and dressing rooms and all workshops and paint shops should be located in adjacent buildings connected by one fire door. The most modern fire appliances, such as sprinklers, should be provided; and lastly the inspection should be eternal. Even then, would there be any guarantee of immunity from loss of life by panic or fire? No; there is not; but we could at least feel that every human resource had been exhausted.

A NEW STUDY OF BIRD LIFE.

The myriads of migratory birds on their way south at this season of the year will be the subject of special scientific study on the part of the various ornithological societies and the experts of the Department of Agriculture. To the average person only indifferently interested in bird life there may seem little in the migration of the summer birds to furnish data for scientific deductions; but the modern student of our native birds sees in these annual flights material for reflection and observation of the greatest importance. The constant relationship existing between our agricultural crops and the migratory birds is a fact that has only in recent years been fully comprehended, and each season new data for study are collected by the expert observers. The problem of weed destruction is, for instance, intimately wrapped up in the migratory habits of the millions of our summer birds. Many of our most noxious garden and field weeds produce in a single season as many as one hundred thousand seeds, and in three seasons a single one of these plants would give birth to ten billion weeds.

There is only one effective agency that keeps in check these prolific weeds. When the seeds of the weeds ripen in the late summer and fall the millions of migratory birds begin their journey southward, devouring the weed seeds at the most critical stage of their lives. A few of the birds eat a number of seeds throughout the whole summer, but the vast majority eat them in the early autumn and early spring, a few staying North with us to pick up the seeds which fall on the ground when covered with snow. They gorge themselves with the weed seeds until their stomachs are distended to three times their normal size. All of our common song and plumage birds are great seed destroyers, and the blackbirds, meadow larks, sparrows, goldfinches, doves, quails, siskins, grosbeaks, and grass birds will eat all the way from one hundred to one thousand seeds of weeds at a single meal. They begin their annual campaign against the weed seeds in the far North as early as late August, and they move southward as the season advances and the seeds ripen in the lower part of the New England and Middle

States. Their migration is consequently due to a large extent to the maturing of the weed seeds, and they move southward only so fast as they devour their favorite seeds in each section. Fortunately, different species of birds choose different kinds of seeds as their favorite food, and very few weeds escape.

Thus the blackbirds make their first raid upon the seeds of the common smartweed or bindweed, and the field sparrows select the seeds of crab grass. Nuttall's sparrow shows a particular penchant for the seeds of the wild amaranth and lamb's-quarters. Tree sparrows are found most frequently hunting seeds of pigeon grass, while the obnoxious pigweed attracts the snowflakes and goldfinches. It is becoming evident to the students of birds that they are influenced almost solely in their migratory habits by the harvest of weed seeds, and not by the climate. We have always supposed that the birds started southward as soon as the chill of autumn approached, but cold, frosty weather might come in August, and the birds would not begin to migrate. They are not weather prophets at all, but simply hungry little creatures following in the footsteps of ripening seeds.

It is quite evident to bird students that many of our birds could be induced to stay North all winter if they could be supplied with an abundance of choice seeds. Some seasons they linger with us so late in the season that wonder is expressed by the casual observer, but the reason for it is that the seeds of some choice weeds have been late in ripening, or the birds have found an unexpected harvest of them in the vicinity. As a visible proof of this constant relationship existing between the migration of birds and the supply of food, it is only necessary to refer to the fact that more birds, and a greater variety, winter in our city parks than can be found in the cold, bleak woods or fields. It has been supposed that these birds have been induced to stay with us because of the greater or less protection they receive in the heart of a city from the cold weather; but the chief reason of their sojourn in the North through the winter is the greater abundance of food found in the city parks. In a thousand ways food is supplied to them in the parks which they could not get in the wild woods and fields. In most of our parks the visitors and school children feed the birds and squirrels, and in late years the department of parks has essayed to supply the winter birds with all the food they could eat. As a direct result of this policy the winter bird inhabitants of our city parks are steadily increasing.

In the new study of bird life, it is becoming evident to those most interested in the subject that it is possible to make our winter birds more numerous by simply feeding them and providing them with winter protection. Bird houses should be more generally constructed. These should be built for the purpose of sheltering the birds from cold snowstorms and wintry winds and rain. They should be built with the north and west side made wind and rain-proof, and the south and east sides with openings and wide verandas where the birds can sun themselves and dry their plumage after a rain. There should be an inner and outward compartment, where the birds can retire in very cold weather. The inner compartment should be supplied with plenty of soft cotton, hay, and woolen rags. To reach the inner compartment it should be necessary for the birds to pass through the first and then down a long passage to a door which opens at the opposite end. In this way the bird house is made suitable for all weather. The walls of the inner compartment should be made double, with felt lining between them. Then in the coldest weather, our most sensitive birds can find ample protection from snow and wind. To introduce them to their new winter quarters, choice seeds and food should be scattered all through the house, and they will gradually follow this, and become enamored of their new home. The cost of constructing such a bird house for winter habitation need be very little. The outside architectural features will of course increase the expense to any sum one may wish to put in the house. With thousands of these built all over the country, our winter population of plumage, and even song birds, would rapidly increase.

There is one feature of bird migration which scientists have made special studies of in the last few years, and which is intimately associated with the food question. It was supposed formerly that migrating birds traveled very rapidly, some covering the distance between the Southern and Northern States in an incredibly short time. Some were even said to fly at the rate of fifty and sixty miles an hour, and to keep this up for eight and ten hours a day, as if anxious to get back to their winter or summer haunts. The very contrary has been found to be the case. The migration journey is a period of harvest-time joy and celebration for the birds, and they are happy and joyful throughout. It is a period of feasting, of gluttony, and oftentimes of song. The birds move slowly, if the food is abundant, lingering in one place for days and weeks where the harvest is particularly good. Instead of traveling rapidly in their great migration, they frequently, in the autumn of the year, move only at the rate of a few miles a day, and not infrequently only a few miles a week. They pass over barren and unproductive places with considerable swiftness, flying in large flocks to some better feeding ground. Observations of their flight at such points may naturally have led some to infer that they move rapidly north and south.

In the northward journey in the spring, they move on an average much faster than in the autumn, for it is then the desire for nesting that urges them onward, while the supply of food is much more limited. The insectivorous birds are most inclined to linger in the newly-plowed fields, but the typical seed-eating birds hurry to their favorite haunts to build their spring home. In selecting this, the food question influences every couple. Scatter daily plenty of food in an orchard, and year by year the number of birds nesting there will increase. This food should be spread out very early in spring, so that the earliest comers will find it. This will encourage them to return earlier another season. G. E. W.

THE DEATH OF JEREMIAH M. ALLEN.

On December 29, Mr. Jeremiah M. Allen, known to every engineer in the United States as the president of the Hartford Steam Boiler Inspection and Insurance Company, died at his home in Hartford, Conn. For thirty-three years he had been president of the company, during which time he had devoted himself with untiring energy to his chosen work.

Mr. Allen was born on May 18, 1833, in Enfield, Conn. Hartford will ever remember him as the first president of her board of trade, organized in 1888, and also for the work which he did while a member and president of the board of trustees of the Hartford Theological Seminary. There is hardly an institution, financial or industrial, of the city of Hartford with which he had not been directly or indirectly connected. Mr. Allen was a member of many scientific societies, among them the American Society of Mechanical Engineers, American Society of Naval Engineers, the American Association for the Advancement of Science, the American Historical Society, and the Connecticut Historical Society.

Mr. Allen for a number of years had been a lecturer on insurance topics at Sibley College, Cornell University, and at the Worcester Polytechnic Institute. This year he was to deliver a course of lectures at Yale.

Mr. Allen was a descendant of Samuel Allen, who settled in Cambridge, Mass., in 1632, and who was an ancestor of Ethan Allen, of Revolutionary fame. The history of the Allen family has been the history of men who have had a bent for mechanics and science. One of the earlier Allens was the first man in the country to make telescopes and microscopes; another was an astronomer.

As a business man Mr. Allen's abilities were amply shown in the wonderful development of the Hartford Steam Boiler Inspection and Insurance Company under his presidency. Its capital increased to over two and a half million dollars. He started a magazine called the "Locomotive," which treats in a bright and entertaining way engineering topics of interest to insurance engineers.

THE NEW BRITISH SHIPBUILDING PROGRAMME.

BY H. C. FYFE.

The British Admiralty have just published the particulars of the new warships which are to be laid down early in the present year. These vessels were provided for in the estimates 1903-1904; but the designs have only just been published.

Three Battleships, "King Edward VII." Class.

Name.	Displacement. Tons.	I. H. P	Speed. Knots.
"Britannia" "Africa" "Hibernia"	16,350	18,000	18½

Four Cruisers, "Duke of Edinburgh" Class.

Name.	Displacement. Tons.	I. H. P	Speed. Knots.
"Warrior" "Natal" "Cochran" "Achilles"	13,550	23,500	22⅓

Four Scouts, 25 Knots.

Name.	Displacement. Tons.	I. H. P
"Skirmisher"	2,900	17,000
"Foresight"	2,545	16,000
"Attentive"	2,750	16,000
"Patrol"	2,810	16,000

Fifteen Torpedo-boat Destroyers.

Length, 220 feet; beam, 20½ feet; speed, 25½ knots.

Ten Submarines. To be built by Vickers' Sons & Maxim.

The three new battleships are to be built in the royal dockyards. They are to be named "Hibernia," "Britannia," and "Africa." They will resemble in most details the five battleships of the "King Edward VII." class now under construction, viz., "King Edward VII.," "Commonwealth," "Dominion," "Hindustan," and "New Zealand." They will carry four 12-inch and four 9.2-inch guns in six turrets; ten 6-inch rapid-fire guns in battery; forty smaller guns; four submerged torpedo tubes. The three new battleships will, however, be an improvement on the "King Edward" in certain particulars.

The four new first-class armored cruisers will be of the "Duke of Edinburgh" class, including the two vessels "Duke of Edinburgh" and "Black Prince." They will carry six 9.2 inch, 50 caliber guns in turrets, and ten 6-inch rapid-fire guns in battery, besides twenty-eight smaller rapid-firers.

The four "Scouts" are all of different design, the preparation of the plans having been left to the builders. They are all bigger and more powerful vessels than the four previous "Scouts" now building, viz., "Sentinel," "Forward," "Adventure," and "Pathfinder," whose displacement is 1,600 tons, and armament consists of ten 3-inch guns.

The fifteen torpedo-boat destroyers are to be stronger vessels than the 30-knot type.

SCIENCE NOTES.

It is stated that a mixture of salol and antipyrine is employed to give a fictitious melting point of 20 deg. C. to oil of geranium; and that the mixture is largely used to sophisticate otto of rose.—Jour. Pharm. d'Anvers.

Maryland has now the best magnetic survey of any country except Holland, and it needs it, since Washington is near a very pronounced disturbance. The magnetic survey of the United States is being reorganized, and by 1910, it is planned, there will be one magnetic station to every 25 or 30 square miles; at present Holland has one to every 40 square miles, and England one to every 139 square miles. Canada, it is hoped, will join in this, as in the other meteorological work of the United States. Five magnetic observatories are contemplated.

Dr. Bauer, of the United States Coast and Geodetic Survey, has calculated the earth's magnetic energy. Calculating the total energy of the magnetic field outside the earth's surface in spherical harmonics, Dr. Bauer finds that there has been a loss of three per cent in the total energy between the years 1888 and 1884. That would indicate that the earth's magnetism is dying out. But the results are too uncertain. It is curious that we should be more certain about the earth's potential of fifty years ago than about the present potential.

Colors of Autumn Leaves.—The bright colors assumed by maple, sumacs, and ampelopsis during the autumn months are the result of the oxidising of the color compounds, or color generators, of the leaf cells. Long-protracted cool weather is most favorable to the production of autumn tints, and slight frosts that are not severe enough to kill the cells hasten the display of beauty by producing an enzyme that brings forth the bright purples, oranges, and reds. Leaves containing much tannic acid never give bright autumn tints, while those containing sugar give the very prettiest.

In the course of some digging operations in a garden at Haslemere, Surrey, England, a gardener unearthed a number of ancient vessels of peculiar shape, together with a quantity of calcined human bones, at a depth of about two feet below the surface. The British Museum authorities who have examined the discovery pronounce the vessels to belong to the late Celtic (early iron) age, about B. C. 150. E. W. Swanton, the conservator of Dr. Jonathan Hutchinson's Educational Museum, carefully examined the fragments, and only three or four vessels were found in a perfect condition. He computed that twenty-two urns and pots were originally interred at the spot.

Dr. Charles H. Herty, an expert on the subject of forestry and an *attaché* of the United States Bureau of Forestry, is the inventor of a new method of gathering turpentine which will revolutionize the methods now in vogue, and be the means of saving an immense amount of money to the South, where the turpentine industry thrives. Heretofore the crude turpentine has been gathered by cutting a kind of "box" or pocket in the base of the tree, and into this the product found its way from the scarified sides of the tree. The method was not only wasteful, but also damaged the tree to such an extent that its life of usefulness was considerably shortened. It is said that two million acres of virgin forest are "boxed" annually in this way. Dr. Herty is a Southerner, and foreseeing the eventual ruin of a great industry, set about to arrive at some other means of extracting the resin, which he has succeeded in doing in a manner which meets all the demands of the case and increases the production by about seventy-five per cent, by the recovery of that which was formerly wasted and the improved quality of that gathered. The apparatus made use of by Dr. Herty is simple and inexpensive, consisting as it does of an earthenware cup with a nail hole near the top, a six-penny wire nail to hold it in place, and a pair of galvanized iron troughs to divert the flow of resin into the cup. Dr. Herty has not attempted to enrich himself by a monopoly of what is a patentable article, but has announced that the use of the process is public property. As the turpentine industry of the South is a very important one, this gift represents a money valuation of considerable size.

A FLOATING THEATER.

BY W. FRANK M'CLURE.

Perhaps the most interesting of new vessels plying the Ohio, Illinois, and Mississippi rivers is one built upon an extensive scale for use as a floating theater. The seating capacity is for 1,000 people, and there are boxes for the *élite* and a pit for the orchestra. In addition, the vessel is sufficiently large to admit of numerous sleeping rooms for the actors, the deckhands, and all those connected with either the show or the boat. The entire force numbers forty. On the steamer which tows the floating theater, besides the boilers and engines, there is a complete electric light plant, besides a kitchen and dining room.

In view of the fact that the long water route of the floating theater carries it into the warmer portions of the South, the season for the show does not close until late in the southern winter. The entire route comprises 2,500 miles. The boat starts at Pittsburg and visits the towns of the coal miners and steel workers along the Monongahela River. Next it returns and goes down the Ohio to the Kanawha, thence to Cairo, and later up the Illinois River to La Salle. Then after going back to the Mississippi, the boat slowly makes its way in the direction of New Orleans. The idea of a floating theater is not exactly new, but the extensive scale upon which it is being carried on and the fact that it is the drama instead of the vaudeville programme that is being presented, attract unusual attention to the boat herewith pictured. "Faust" is the production which has been presented this season.

THE INTERIOR OF THE FLOATING THEATER.

Along the route of the floating theater the towns are often but ten or fifteen miles apart. Therefore the jumps of the boat and its company are not long ones. On the upper deck of the steamer is a calliope. Long before the theater reaches the town in which it is to show, the sounds of this instrument may be heard. The idle population of the river towns at once begins to assemble on the wharf. As the steamer comes within a few hundred feet of the dock, the calliope is silenced and a brass band strikes up a familiar air. The crowd on the wharf then grows larger. Many are there awaiting the first opportunity to secure reserved seats. When the boat touches the wharf the sailors, some of whom later are transformed into actors, make the vessel fast and put the gangplank in place. The scenery is arranged and the orchestra rehearses while the cook is preparing the next meal in the kitchen. The people come aboard and select their seats instead of doing so from a diagram on shore. At night the theater is brilliantly lighted by electricity and a searchlight flashes over the surrounding territory. The entertainment lasts about three hours.

THE FLOATING THEATER WHICH TRAVELS A ROUTE OF 2,500 MILES.

A NEW CHLOROFORMING APPARATUS.

BY EMILE GUARINI.

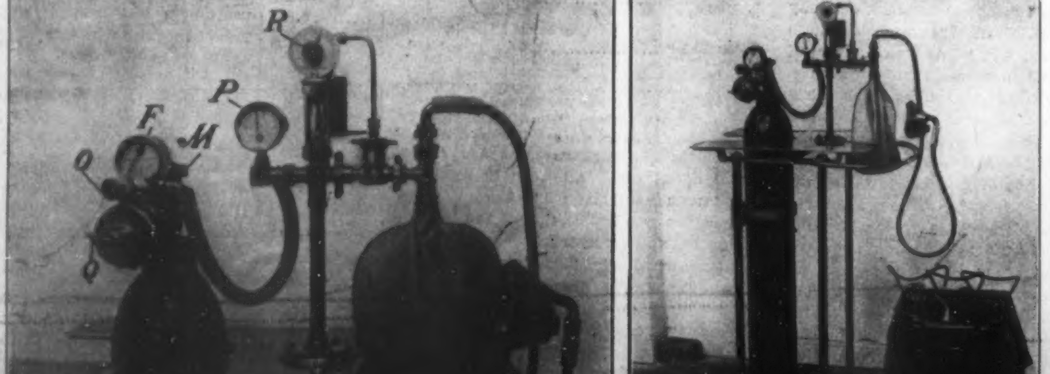
We illustrate herewith a very interesting apparatus for the administration of chloroform which was invented some time ago, and experimented with upon an extensive scale, by Dr. Roth-Draeger in collaboration with M. Guilleiminetti. Chloroform, as is well known, is the best of anæsthetics, but the administration of it is a dangerous and delicate operation. So, as long as death or danger lurks in chloroformization, it is the duty of scientists to seek a means of obviating all mischances. For this purpose, inhalations of oxygen have been employed, and this method was proposed by Ducray so long ago as 1850, in a note to the Academie des Sciences. The good effects of anæsthesia obtained with chloroform mixed with oxygen have been noted by Krantzmann, of San Francisco, Northrop, Schall, Hart, Prochoconik, Championnière, and Neudorifer, who pumped this gas through a Junker apparatus. But the difficulty experienced, up to but a few years ago, in procuring chemically pure oxygen, necessarily contributed toward discouraging innovators. Even granting that oxygen were of no importance to anæsthetized persons, the value of the apparatus is not diminished. It allows a patient to respire a mixture of air, oxygen, and chloroform, the quantity of the latter being exactly proportioned per minute by the current of oxygen, regulated to 3 or 5 liters per minute. The apparatus is provided with an expander of precision, to the construction of which M. Guillelminetti has contributed by his researches upon the efficiency of the inhalations of oxygen in mountain and balloon sickness. The exact quantity of chloroform mixed with the air by the oxygenated current, that is to say, the proportioning of the mixture, is of considerable importance, and herein lies the merit of the new apparatus. With a mixture of 25 grammes of chloroform and 100 liters of air, a dog is killed in 10 minutes, but with 6 grammes of chloroform to 100 liters of air, it is kept under perfect anæsthesia for 6 or 7 hours. The labors of Paul Bert have demonstrated that the anæsthetic state depends upon a certain tension of the gas in the blood kept up by the tension of such gas in the air respired, and that it is a question not of the quantity, but of the proportion of the gas mixed with the air. The apparatus under consideration permits of administering chloroform always mixed with a certain quantity of oxygen and air, and never in too concentrated a state. In this way it completely abolishes the injurious local action of concentrated chloroform upon the mucous membrane of the respiratory tracts, so that there is no longer any danger of laryngeal spasms, of suffocation, or of glandular hypersecretion. In case of symptoms of asphyxia in the course of a long anæsthetization of a patient exhibiting a weakness of the heart, it is possible to use the current of oxygen alone and cease the administration of chloroform.

Anæsthesia has already been produced thousands of times with this apparatus in the Hospital of Hamburg-Eppendorf and in that of Lübeck, etc., and all the administrations have proved more effective and easy than with the compress or mask. The interesting point is the small quantity of chloroform employed, from 20 to 40 grammes sufficing for an anæsthetization of from 1¼ to 1½ hours. From an economic standpoint, the expense involved by the use of oxygen is compensated for by a saving in chloroform.

The apparatus comprises: (1) a metal cylinder containing oxygen under a pressure of from 120 to 150 atmospheres; (2) a cock that permits of turning on the current of oxygen, and another that permits of proportioning the quantity of chloroform per minute; (3) a glass flask containing the chloroform; (4) a bag of goldbeater's skin serving as a temporary reservoir for the oxygen; and (5) a metal mask. This latter is provided with a small aperture for the entrance of pure air, so that the patient shall not inhale pure oxygen. The patient inhales about 8 liters of air per minute. If 3 liters of oxygen are given, he will inhale from the exterior through the aperture 5 liters of air. As such air contains 1 liter of oxygen and 4 liters of nitrogen, the patient will inhale a 50 per cent mixture of air and oxygen. The mask is provided likewise with a wide aperture furnished with a valve for expiration.

The expander causes a lowering of the pressure of the oxygen, which passes into a tube and, acting after the manner of the Bunsen burner, sucks up the chloroform contained in the flask. A cock permits of regulating the suction and, consequently, of administering the chloroform in varying quantities. After the mixture is formed, it passes into the bag, where it accumulates during the expiration, and whence it escapes during the aspiration.

In order to make use of the apparatus, the main valve, *M*, of the oxygen cylinder is opened, and then the supply valve, *O*, of the same. The pressure, being too strong, is reduced by actuating the thumb-screw, *Q*. The quantity of oxygen per minute is then regulated according to the indications of the gage, *P*. The proper quantity of chloroform is given by means of the valve, *R*. By shutting off the oxygen at *O*, the inhalation of the chloroform is arrested. If it be desired to administer oxygen only, all that has to be done is to close the chloroform valve, *R*. The gage, *F*, indicates the quantity of oxygen remaining in the cylinder.



A NEW APPARATUS FOR THE ADMINISTRATION OF CHLOROFORM.

In order to begin the anæsthetization, the oxygen alone is allowed to flow into the mask for from one to two minutes, and the patient is requested to take a deep inspiration. Then the indicator of the chloroform valve, *R*, is put upon the figure 10 or

15 (indicating the drops) in order to accustom the patient to the anæsthetic. After a few seconds, the operator raises the figure to 25 or 30 drops if the patient is a woman, and to 40 to 50 if a man. This quantity is maintained for four or five minutes. After the patient falls asleep, the quantity is diminished to 20 to 15 drops in order to keep up the anæsthetization, which is always excellent and calm.

ELECTRICITY ON THE MIAMI AND ERIE CANAL.

The general interest which has been aroused by the appropriation on the part of the New York legislature of $101,000,000 for the improvement of the State canals, and also by the various attempts which have been made within recent years to use electric power in drawing the barges of the Erie Canal, lead us to suppose that an account of the Miami and Erie Canal, the only waterway in this country which is successfully operated by electricity, and the only example in this country of three-phase traction, will not be without interest to our readers. The work of electrifying the Miami and Erie Canal is due largely to the energy of Thomas N. Foredyce, who, in 1900, conducted a series of experiments with an electric towing locomotive which ran along the banks of the canal on a specially built track. Through the courtesy of Charles W. Ricker, an engineer, who rendered valuable assistance in the electrification of the canal, we are enabled to present illustrations of the waterway, and likewise to present a full account of the installation.

Active work was begun on the Cincinnati-Dayton section, 68 miles long, in July, 1901. The section is nearly completed, and the stretch from Cincinnati to Middletown, some 42 miles in length, is now in operation. The table in the footnote gives the length and depth of the canal.*

Along the line of the canal are 95 locks, each 90 feet long and 15 feet wide. The gates are of the wood, swinging-miter type, and are operated by hand. There is but one summit level, which is 395 feet above Lake Erie and 512 feet above the Ohio River. Its length is 23 miles, beginning 100 miles north of Cincinnati. The high levels are supplied by three artificial lakes and by rivers.

The canal boats are towed in a string by a locomotive running on the tow path. Before electric locomotives were used, each boat required, for twenty-four hours' operation, a crew of two steersmen, two drivers, and one cook—in all five persons—besides five mules.

* From	To	Distance Miles	—Width in Feet— Water line	Bottom	Depth Feet
Cincinnati	Dayton..................	66	40	26	4
Dayton	Junction.................	114	50	36	5
Junction	Toledo..................	64	60	46	6
Cincinnati	Toledo..................	244	..	..	..

The average speed was about two miles an hour. With the new system, each boat needs only two men and the locomotive four men for the same period of time. The speed has been increased to three miles per hour. The numerous curves and irregularities of the channel render it impossible to string together more than ten boats, each 80 feet long. Abut 200 feet of line are used between the motor and the first boat, and 50 feet between boats, so that an electric mule drags a tail some 1,500 feet in length.

Since the whole length of the canal is to be supplied from a moderate number of generating stations, the principal transmission is naturally by alternating current at high tension, with reducing sub-stations at intervals along the line. Owing to the small number of large units forming the load, and their ability to bunch, the sub-stations must be placed far apart, or some of them will be idle much of the time, thereby involving a low all-day efficiency. The average demand per unit is high, involving a high average line loss. These conditions rendered it necessary to select a high trolley voltage. The running conditions are such that induction motors can be used to advantage. Stops are infrequent. A string of boats must be set in motion slowly in order to prevent breaking of the towing lines. Hence the slow starting torque, as compared with series motors, is not a serious objection. The higher trolley voltage possible assures good regulation and a good starting torque without excessive expense for copper.

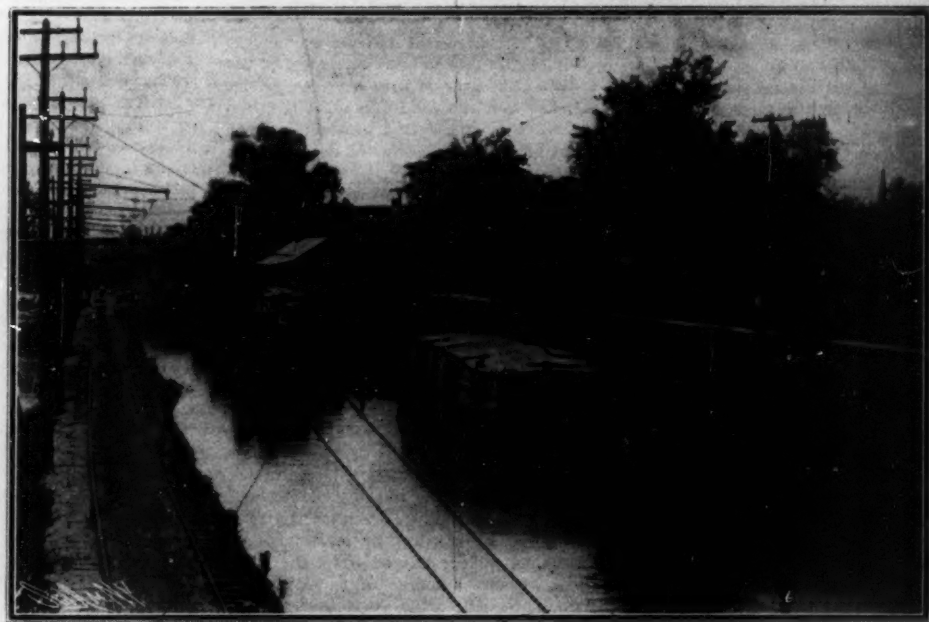
The Cleveland Construction Company, who designed the electrical equipment, installed an alternating-current system throughout, with locomotives equipped with three-phase induction motors to which energy is supplied from a three-conductor line, consisting of two overhead trolley wires and the track.

The track is built along the towpath with the finished surface 2 feet above the water level. Between Cincinnati and Hamilton, the canal lies mostly along hillsides, with the towpath on the higher bank, which is about 16 feet thick at the water line, with slopes of 1½ to 1. The sub-grade is 12 feet wide. The central line of the track is about 6 feet from the water's edge.

Along the main line, the maximum curvature is 25 degrees. In Cincinnati, however, there are sharp curves which require a very short wheel base for the locomotives. The only grades are at locks and depressions under low bridges. The steepest slope is 2 per cent. Within the city limits, railroad bridges and street bridges could not be raised, so that the tracks under them had to be depressed to allow the locomotives to pass. At three places the towing track crosses the canal. Where a drawbridge has been installed it must be opened immediately after the motor has passed to allow the boats to float through. Quickness of movement is important.

A three-phase, 60-cycle current at 4,200 volts is delivered at the switchboard and transmitted over the transportation company's lines, 5 miles distance to the first station—just within the northerly limit of Cincinnati. This is a motor-driven generating station which supplies the first trolley section, extending from the Cincinnati terminal northerly 7½ miles, at 390 volts, 3-phase, 25 cycles. Static transformers raise the pressure for transmission along the canal to the other stations, where it is reduced to 1,170 volts for the three-phase trolley circuit. In all, there will be four reducing stations about 12 miles apart, the most northerly about 6 miles south of Dayton. A typical station is that which is known as No. 2, at Rialto—typical because all the other reducing substations are to be exactly like it. The equipment consists of three 150-kilowatt, 25-cycle, 33,000-volt to 1,170-volt self-cooling oil transformers connected in delta in both primary and secondary. Each substation is placed at the middle of the station which it is to supply.

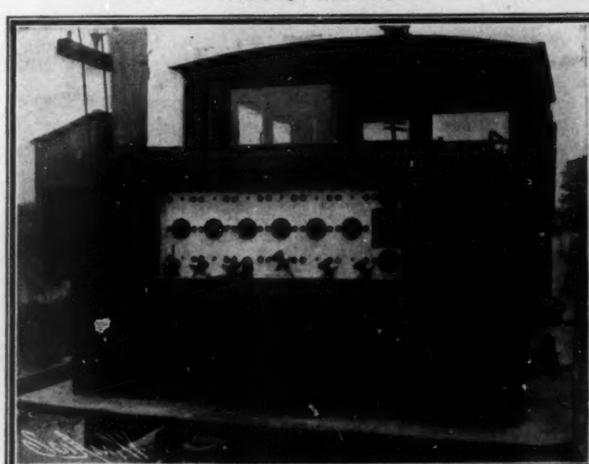
The 33,000-volt transmission line from the transportation company's station No. 1 consists of three aluminium cables made up of seven strands of wire. These are arranged in the form of a triangle at the top



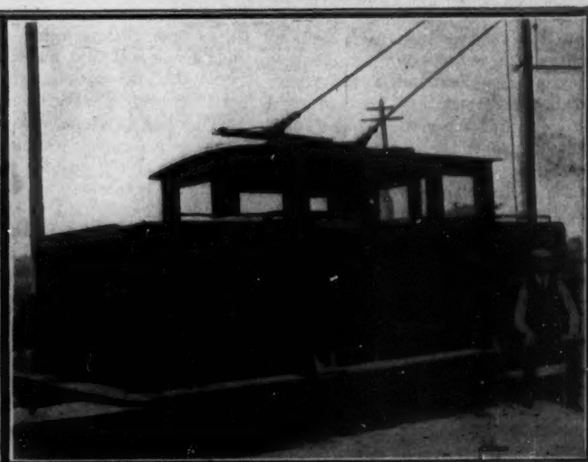
A Scene Along the Canal, Showing Overhead Lines and Track.

Switching Locomotive.

The Construction Motor.



End of Locomotive Showing the Primary Switchboard.



One of the Standard Electric Towing Locomotives Used on the Miami and Erie Canal.

ELECTRICITY ON THE MIAMI AND ERIE CANAL.

of the poles, with one wire above and two below. The 4,200-volt transmission line from the generating station to the transportation company's station No. 1 is strung of the same cable as the 33,000-volt line.

The electric locomotives, built by the Baldwin Works, each weigh about 55,000 pounds, and are equipped with two 80-horsepower induction motors, delta-connected, of a normal speed of 720 revolutions per minute. These are connected to the axles through double reduction gearing, and when operating in tandem propel the locomotive at about three miles per hour. Either gear alone will propel the locomotive at double this speed; but under the State law boats cannot be towed at higher speeds. Each locomotive contains three 25-kilowatt self-cooling oil transformers, which reduce the trolley voltage from 1,170 volts or 390 volts to 200 volts for the motors. The motor-changing switch, similar in pattern to an ordinary railway controller, serves to connect the two motors in tandem, or to connect either one to the line and cut out the other, or both. A controller, similar in form to the changing switch, serves to delay the resistance of the rheostat in circuit and to operate the reversing switches, so that the movement of the controller handle in one direction reverses it at the middle position of the handle. At one end of the locomotive is a plug switchboard, by which the primary connections of the locomotive transformers are changed to suit the trolley for each one passing between the high-tension and low-tension sections.

Owing to the large number of low bridges, the extreme height of the standard locomotives is limited to 8 feet, 6 inches, and the extreme height of the switch locomotive, used at the southerly end of the line in Cincinnati, is only 5 feet, 6 inches. Starting and running continuously at three miles per hour, the motors connected in tandem develop 40 horse power each.

American Commerce in 1903.

Details of eleven months' commerce of the year 1903 are just made public by the Department of Commerce and Labor through its Bureau of Statistics. They show an increase in practically all of the great groups into which the Bureau of Statistics divides the exports and in all of the groups into which it divides the imports. Agricultural products as a whole, show an increase of 74 million dollars; products of the forests, 10 millions; products of the mines, 8 millions; manufactures, 5 millions, and miscellaneous articles, 2 millions. In the single group, fisheries, is shown a slight decrease of a little more than $1,000,000.

The figures for the month of November show a marked growth in exports of manufactures, the total for the month being $34,093,639, against $30,513,512 in November of last year. Agricultural products also show a marked increase in the month, the figures for November, 1903, being $114,172,255, against $83,035,850 in the same month of last year. The increase in agricultural exports occurs chiefly in cotton, of which the value of the month's exports is unusually high.

The increase in exports of manufactures is distributed through many articles, but does not occur, as had been expected, in iron and steel. Discussions in trade circles and in the press during the past few weeks have predicted a revival in the export trade of iron and steel manufactures, but the November figures of exports of this class of merchandise do not justify this prediction. The total value of iron and steel manufactures exported in November, 1903, was $7 988,415, against $8,119,924 in November of 1902, $8,180,193 in November, 1901, and $10,112,721 in November, 1900. For the eleven months ending with November the total exports of iron and steel manufactures are $89,685 201 in value, against $90,136,124 in the corresponding months of 1902, and $94,112,782 in the corresponding months of 1901. Notwithstanding the slight decrease in exports of iron and steel, the total of all manufactures exported during the eleven months ending with November, 1903, is $382,768,127, against $377,757,576 in the corresponding months of last year.

Imports for the month show a decrease of over $8,000,000 compared with November of the preceding year. This decrease is divided between manufacturers' materials, food stuffs, and the group designated as "articles of voluntary use, luxuries, etc." The largest decrease occurs in the group "articles wholly or partially manufactured for use in manufacturing," the reduction in this class being about $3 000,000, as compared with the corresponding month of the preceding year. This reduction occurs largely in iron and steel, of which the importations for the month are less than half those of the corresponding month of last year, the figures for November, 1903, being $2,309,233, against $4,779,093 in November, 1902. For the eleven months ending with November articles wholly or partially manufactured for use in manufacturing show an increase of $15,000,000 over the corresponding months of last year, while articles in a crude condition for use in manufacturing show an increase of $11,000,000 in 1903, as compared with the corresponding months of 1902.

Summarizing the story told by the figures for the month of November and the eleven months ending with November, it may be said that they indicate a growth in exports of manufactures, but that the expected increase in exports of iron and steel manufactures has not developed. Imports of iron and steel manufactures, however, show a decrease in November, 1903, as compared with November, 1902, though for the entire eleven months the figures of iron and steel imports are slightly in excess of those of last year. Importations of other manufacturers' materials also show a slight decrease in November as compared with November of last year, but a marked increase when the eleven months ending with November are considered in comparison with the corresponding months of last year.

These figures of commerce of the eleven months would seem to indicate that the total commerce of the United States during the year was greater than in any preceding year, but that the total exports will fall a few millions below those of 1900 and be about equal to those of 1901, but materially in excess of those of 1902, while the total imports will exceed those of any preceding year, and combined with the exports make the grand total of commerce more than in any earlier year; also that the exports of manufactures will exceed those of 1902 by several millions, but be somewhat below those of the record year 1900, and perhaps 1901.

New Phenomena Produced With the N-Rays.

Since his discovery of the new form of radiation which he calls N-rays, M. R. Blondlot has been making further experiments on this subject, which he sets forth in a paper read before the Académie des Sciences. When a beam of N-rays is let fall upon a small spark, flame, or phosphorescent substance previously exposed to the sun, or a sheet of platinum at a low red heat, the light which is emitted by these substances is noticed to increase in brightness. In all such experiments, an account of which has been previously given, he uses a source which emits light of itself. It might then be asked what would be the effect of letting the N-rays fall upon a body which is not a direct source of light, but reflects it or otherwise transmits it from an outside source. Following this idea he brings out some interesting facts in the present series of experiments. A band of white paper 0.6 inch long and 0.1 inch wide is fixed vertically on an iron wire support. The room is darkened, and the band is dimly lighted by projecting on it laterally a beam of light coming from a small flame inclosed in a box provided with a vertical slit. The N-rays are now produced in an apparatus consisting of a Welsbach burner inclosed in a sheet-iron cylinder. In the cylinder is a rectangular slit 2.4 inches high and 1 inch wide. The whole is placed inside a lantern-shaped box of sheet iron having an opening opposite the slit which is covered with a sheet of aluminium. In front of the opening is placed the paper band, lighted as above mentioned, and the beam of N-rays falls upon it. If the N-rays are now intercepted by placing a sheet of lead or the hand in their path, the paper strip is observed to become darker and its outlines lose their sharpness. On removing the screen again, the original brightness is restored. It is evident that the light which is diffused from the paper is increased by letting the N-rays fall upon it.

Pursuing this idea it is evident that the diffusion of light is a complex phenomenon in which the elementary fact is the regular reflection, and therefore the next step is to observe whether in fact the phenomenon of reflection of light is not modified by the action of N-rays. This was found to be the case, as was proved by a simple and conclusive experiment. A polished steel knitting-needle is fixed upright in place of the paper band. A source of light is placed inside a box, which is completely closed with the exception of a vertical slit just before the burner. The slit is covered with translucent paper. By placing the slit and the eye in a proper position relative to the needle, the image of the slit is seen reflected from the steel cylinder. At the same time the reflecting surface is exposed to the beam of N-rays coming from the apparatus. It is observed that in such case the action of the N-rays reinforces the reflected image, for if the rays are intercepted by a screen, the image darkens and becomes reddish. The same effect is observed by using a small plane mirror in place of the needle.

An interesting phenomenon is observed when a polished plate of quartz is used to reflect the rays. Here the effect is the same in general, but when the N-rays are let fall perpendicularly to the surface, their action on the reflected light disappears, whatever may be the angle of incidence of the reflected rays. This action may become *nil* or only imperceptible. To have the reflected light from the quartz reinforced by the N-rays, it is not necessary that these should be sent from the exterior to the interior of the quartz, as above. The action still takes place when the N-rays traverse the quartz from the back to the front. In these experiments it is found that the action of the N-rays upon light requires an appreciable time to become manifest and also to disappear. No effect could be observed of the N-rays upon refracted light, although the experiment was repeated in different ways. With a small source of light the effects are sometimes difficult to distinguish with the unpractised eye, but this should not be a drawback to the study of these hitherto unknown radiations. With a Nernst lamp of 200 watts as a source of the N-rays, the effects become striking enough, however, to be observed by anyone.

Electrical Notes.

An Italian scientist claims to have established that electric tramways are great mediums in the disinfection of towns. He points out that the electric spark, which is so frequent an occurrence to the overhead trolley, and the emission of light from the car wheel when the rail is used for the return current, transform the oxygen of the air into ozone, which has a purifying and disinfecting influence. The high discharges, he says, are frequent enough to influence greatly the atmospheric constituents, especially where the line passes through narrow thoroughfares. They become antiseptic agents.

The plant of the Washington Water Power Company at Spokane, Washington, is about to be started. This is one of the most important installations on the Pacific slope, the length of the transmission being 110 miles. The bulk of the power will be used for mining purposes, 1,200 horse power being delivered to the Standard and Hecla mines, where it will be used for driving compressors, hoists, and similar work. It is anticipated that the operation of this plant will open a rich mining country, which has been thus far neglected because of its inaccessibility. These power electrical plants in the far West have developed a number of "troubles" which are not generally encountered by the engineers in the East, and the Washington plant is no exception. A large portion of the line runs through a marsh, and last winter, after the poles had been planted, the ice formed around the butts and gradually lifted them from the holes. This has been overcome now by fastening a horizontal cross piece to that part of the pole which is placed below the surface.

For more than two years two small factories, one near Leipsic, the other near Hamburg, have been driven successfully by windmills, which are also used as a means of generating electricity for lighting purposes. According to the Elektrotechnischer Anzeiger, the windmills have a diameter of 5 meters and 5½ meters respectively and are mounted on the roof of the works. To insure reliability, the wind wheel itself has no moving parts, the speed regulation being obtained by turning the windmill so as to vary the angle under which the wind impinges upon the sails, which are built of steel sheets. This is performed by a small auxiliary wind motor, and is said to be done so quickly and accurately that the voltage of the dynamo remains practically constant throughout the range of ordinary wind pressures. An automatic switch cuts out the battery connected in parallel with the dynamo as soon as the wind falls below a certain point. In one of the cases mentioned the battery may be divided into two parallel groups when it is necessary to utilize unusually low winds.

At the recent meeting of the National Street Railway Associations at Saratoga, N. Y., Mr. W. L. Emmet, of the General Electric Company, stated that the 5,000-kilowatt Curtis turbine unit built for the Commonwealth Electric Company, of Chicago, had been installed and tested, with successful results. This is the third Curtis turbine put into commercial operation, the first having been a 600-kilowatt machine installed in one of the plants of the General Electric Company, and the second a 500-kilowatt machine erected at Newport, R. I. The first machine has now been in successful daily use for two years. A condenser is being developed which will form part of the turbine base for the Curtis engine. With steam turbines the condenser vacuum is a very important matter, a high vacuum being essential to good steam economy. In the discussion of Mr. Emmett's paper, Mr. J. I. Beggs expressed the belief that future practice would show the steam turbine to fall behind the gas engine just as the reciprocating steam engine is falling behind the turbine. There was, however, a difference of opinion as to this probability, as would naturally be expected. Mr. C. O. Mailloux, of New York, stated that in general the greater first cost of the gas engine plant, entirely aside from the questions of floor space and foundations, would more than offset any operating economy that could be realized from it, except under certain special conditions. Mr. Emmet in replying to the criticisms stated that the actual performance of gas engines under working conditions does not exceed that of steam turbines, and made the important point that the steam turbine is extremely simple in its construction and operation whereas the gas engine is very complicated.

Correspondence.

The Truth About Dr. Lardner and the Transatlantic Steamship.

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been drawn to some remarks that appeared in your valuable periodical, rather a long time ago, for they were in the number of January 11, 1902, on the subject of first iron vessel in Great Britain. The writer of these observations asserts that absurd as it now appears, Dr. Lardner, a scientific authority, declared that the idea of an iron ship was perfectly chimerical, and that there was about as much chance of an iron boat reaching New York from Europe as there was of its voyage to the moon. The assertion is no doubt a variation of a story that has been repeatedly told and as often contradicted. The story, as generally told, has no basis in fact, and this particular variation is even more improbable. A false statement, particularly if it affect the reputation of any [illegible]it is well known, dies hard, but perhaps you will permit me to attempt to kill this one.

Only a few years ago (1897) Lord Hopetoun, in his presidential address to the Institution of Naval Architects, repeated the story in its usual form, which is that Dr. Lardner had expressed the opinion that steam navigation across the Atlantic was impossible. On July 16 of the same year he was hauled over the coals in the columns of The Engineer, by an able writer, whose name I do not know. A whole column or more was devoted to the vindication of Dr. Lardner, and the opinion was expressed that it was important to settle this story once for all and to prevent the variant versions flattering to the ignorant mind being handed down from age to age in company with similar facetious anecdotes, applied with much sameness to the eminent philosophers of every time.

A year, however, before this article appeared in The Engineer, the subject came up in a discussion at the Royal Colonial Institute meeting on June 9, 1896, when the Marquess of Lorne was in the chair. Sir Sandford Fleming, K.C.M.G., then Mr. Fleming, in reading a paper on "Canada and Ocean Highways," repeated the unfounded story of Dr. Lardner's opinion that transatlantic steam navigation was impossible. It so happens that Mr. W. G. Lardner, a grandson of Dr. Dionysius Lardner, is a fellow of the Royal Colonial Institute, and as such had a slip copy of the paper to be read sent to him beforehand. He invited his father, Commissary-General G. D. Lardner, F.R.A.S. (since dead), to attend the meeting and vindicate Dr. Lardner's memory. This he did in the discussion that followed the reading of the paper, in the following words:

"My object in rising is to give an explanation of a somewhat personal character in reference to an allusion made by Mr. Fleming to a gentleman, deceased forty years ago, whom I had the honor to call my father. In the course of his admirable paper, Mr. Fleming alludes to the general belief that Dr. Lardner, in lecturing at Liverpool in the year 1835, had declared that a voyage by steamship to the American continent from Europe was perfectly chimerical, and that people might as well talk of making a voyage to the moon. Probably Mr. Fleming is not aware that this supposed declaration originated in an erroneous press report, and was at once and at the time contradicted by Dr. Lardner, who set forth in unanswerable language, not only what he meant to say, but what he actually did say. This disclaimer was republished in the last edition of his work, 'The Steam Engine' (eighth edition, 1851), as the following extracts will show. In the preface to this work Dr. Lardner wrote:

"'In the third chapter of the second part will be found a review of the progress of steam navigation from its first establishment in 1812 to the present day. This chapter also contains the refutation of those absurd reports which have been generally circulated, imputing to the author opinions as to the impossibility of the Atlantic voyage, which are precisely the reverse of those he really expressed.'

"At page 295 of the above work is a report from the Times of Dr. Lardner's speech at the meeting of the British Association at Bristol on August 25, 1836. From that report, which appeared in the Times August 27, 1836, I extract the following:

"' . . . He (Dr. Lardner) was aware that since the question had arisen, it had been stated that his own opinion was averse to it. This statement was *totally wrong*. . . .'

"After some observations from Messrs. Brunel and Field, Dr. Lardner in reply said that 'he considered the voyage practicable, but wished to point out that which would remove the possibility of a doubt, because if the first attempt failed it would cast a damp upon the enterprise and prevent a repetition of the attempt. What he did affirm and maintain was that the long sea voyages by steam which were contemplated could not be maintained with the regularity and certainty, which are indispensable to commercial success, by any revenue which could be expected from traffic alone; and that, without a government subsidy of a considerable amount, such lines of steamers, although they might be started, could not be permanently maintained.'

"Nevertheless the charge has been brought up again and again, and has been reproduced in public places for no other conceivable motive than perhaps to point an imaginary moral, or adorn a sensational statement."

Referring in 1851 to his own prophetic words of 1836, Dr. Lardner wrote:

"Thus it appears that after a lapse of nearly fourteen years, notwithstanding the great improvement in steam navigation, the project advanced at Bristol and there pronounced by me *commercially* impracticable, signally failed."

As pointed out by the writer of this article in The Engineer, the *commercial* inferiority of steamships to sailing clippers as cargo boats continued till the advent of the compound principle in marine engineering.

Whether the republication of the above facts will prevent the repetition of the absurd stories in circulation as to Dr. Lardner's opinions on the subject, I am doubtful, so convenient are these depreciatory inventions about great men of the past to flatter the superior intelligence of small men of the present; but, at any rate, as you have unwittingly given prominence to this untrue story, I am sure you will, in justice to the memory of so distinguished a man of science as Dr. Dionysius Lardner, permit me, even at some length, to make known its entire want of foundation.

ROBT. H. VETCH,
Colonel, Royal Engineers.

London, December 1, 1903.

Nordmann and the Aurora Borealis.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 5 is an article "An Electromagnetic Theory of the Aurora Borealis." Without going into any discussion or criticism of Mr. Nordmann's magnetic theory, I desire to state a few facts in regard to the phenomenon, which I have personally observed in Sweden.

1. "Northern Lights," Aurora Borealis, occurs at its best during the autumn season.

2. Sometimes it appears as a steady light, seemingly emanating from far behind the northern horizon.

3. At other times it appears as if emanating from above the clouds at the northern horizon. Usually the rays appear in groups, changing in dimension and moving to and fro from one side of the sky to the other.

4. Sometimes, but not very often, the Aurora Borealis extends back to the zenith in Ostergötland, and even south of that province. This was most marked, as I can remember, about the year 1871. When the Aurora Borealis seems to emanate from right overhead, then the temperature is at first unusually warm and the air calm. But after a short time small whirlwinds arise, some of them warm and some cold, and the air begins to circulate. Some of the small scattered clouds in the sky can be seen moving up and down, and there is even a little thunder and lightning; but gradually the wind increases and takes a more steady direction.

From these facts I have concluded that the Aurora Borealis is a thermo-electrical phenomenon.

O. T. NILSSON.

Rockford, Ill., December 26, 1903.

Strength of Railroad Cars.

To the Editor of the SCIENTIFIC AMERICAN:

Being a regular reader of your publication, the SCIENTIFIC AMERICAN, I have noticed at various times in your valuable columns articles advocating the use of fireproof railway cars, especially electric railway cars. I think in view of the recent awful disaster at Dawson, Pa., if through your editorial columns you advocate wreck-proof cars you would do great humanitarian benefit, for your paper has great weight.

It seems to me that if each of the great railways of this continent would subscribe say $500 or so, very extensive experiments and tests could be made of full-sized models of passenger cars to determine the best and yet economical construction of such cars to withstand collision, rolling down embankments, fire, etc. These tests could be made by allowing cars to descend a slope on some narrow-gage railway. The speed, momentum, force of impact could be calculated to a nicety. A test of these small cars would give just as valuable information as of larger models.

There may have been such tests made. I have not heard or read of any, however, although I am interested in engineering, being an assistant engineer in the Department of Public Works of Canada, and at the Engineers' Club of Toronto see a number of technical journals.

F. D. WITHROW.

Toronto, Canada.

[Our correspondent will find the answer to his suggestion in the announcement of the Pullman Company, given in our editorial columns, that they carried over thirty-two million people with only ten casualties. The relative behavior of Pullmans and day coaches in railroad wrecks gives us all the data we require.—ED.]

Engineering Notes.

Ex-Mayor Adam H. Leader, of Reading, Pa., is the inventor of four different styles of gasoline engines, the last one of which is supplied with a number of novel features. It requires no tank for the gasoline, the latter being pumped automatically from the base of the engine into the receiver at the top, from which the cylinder is fed. The engine is operated at any angle, and has a new style of igniter, which is said to be superior to any of those now in use. A four-horsepower engine stands 4 feet in height and weighs 650 pounds. Mr. Leader says that the engine is particularly suited for driving a dynamo or for general work on a farm. The cost of running the engine is said to be one cent an hour per horse power.

An entirely new method of constructing underground conduits was recently demonstrated in Neasden, England. A number of lengths of iron pipes were laid in a trench and blocked up a few inches above the bottom. These pipes were about four feet in length, and were joined together in such a manner that the exterior represented an unobstructed surface. The pipes were coated with a composition of paraffine and graphite to the thickness of about one-quarter of an inch. The line was then covered with cement, and after the cement had hardened, a jet of steam was turned into the interior, heating the metal and melting the composition on the outside, which makes the withdrawal of the line of pipe a comparatively easy matter. The inside of the conduit is left covered with a coating which acts as an excellent lubricant, which greatly facilitates the passage of wire and cables through it. The cost of a conduit of this character is given as from twenty-five to thirty cents per yard.

The introduction of blue-prints into the United States was not such a rapid process as the present universal adoption of this method of copying tracings might indicate. The first prints of this nature shown in the country were part of an exhibit in the Swiss section of the Centennial Exposition, and it was stated by one of the gentlemen in charge of that exhibit that the process had but recently been introduced into Switzerland from Germany. Mr. Rudolph Hering was requested to prepare an article for the Proceedings of the American Society of Civil Engineers on the Swiss display, and came across these prints while engaged on this work. He obtained a copy of the formula for the solution, and after some trouble secured the ingredients and tried the process at his home; this was in 1876, and was probably the first case of blue-printing in the United States. He sought to interest the city engineer of Philadelphia in the process, but Mr. Smedley, who then held the office, refused because the operations would be too sloppy. Then he showed some of his prints to Dr. Coleman Sellers, but that eminent engineer refused to see anything good in them. Workmen, he said, were so accustomed to working from drawings in black ink on white or brown paper that the attempt to introduce drawings with white lines on a blue background would be the cause of serious trouble.

The Current Supplement.

The railway ferry steamers built by Schichau have attracted much attention of late. The current SUPPLEMENT, No. 1462, opens with a complete description of these vessels, illustrated by two excellent engravings. "Early Attempts at Submarine Navigation" is the title of an article which will probably be of interest to those who have followed the experiments recently conducted with the "Protector." Albert P. Sy continues his account of the stability tests of nitrocellulose and nitrocellulose powders. Prof. G. B. Howes presents the last installment of his paper on the "Morphological Method and Progress." Mr. Mark Bennett tells much that is interesting of landscape gardening at the Louisiana Purchase Exposition. Prof. Robert Montgomery Bird writes instructively on the theory of light emissions from a flame, and traces the development of that theory. From an engineering standpoint, the most important article of the SUPPLEMENT is that by Bion J. Arnold on "The Arnold Electro-Pneumatic Railway System; its Application and Experiments Therewith in Connection with the Lansing, St. Johns and St. Louis Railway." The paper is excellently illustrated with several engravings.

Prize for Boat-Raising Works.

The Austro-Hungarian Consul-General at New York city informs us that those who are interested in the competition instituted by the Austrian government for designs of boat-raising works to be used on the Donau-Oder Canal may receive full details by writing to the Imperial and Royal Austro-Hungarian Embassy, 1304 18th Street, Washington, D. C. A prize will be given for the best design.

THE OLDEST WORKING LOCOMOTIVE IN THE WORLD.

By courtesy of the Engineer, London, we are enabled to present the accompanying illustration of what was unquestionably the oldest working locomotive in the world. In tracing her history we are taken back to the year 1819, when the owners of the Hetton colliery near Durham decided to change their wagonway into a steam railroad, and secured for this purpose the services of the great Stephenson, who had already made his name in connection with a similar undertaking for the Killingworth colliery. This earlier locomotive was the first that Stephenson built, and it was placed on the Killingworth Railroad on the 25th of July, 1814, and proved its value by drawing eight loaded cars of a total weight of 30 tons up a grade of 1 in 450. The Hetton Railway was eight miles in length and extended from Hetton colliery, which is located a few miles west of the city of Durham, to the shipping point on the River Wear at Sunderland. As the line had to be carried directly across some hilly intervening country, it was necessary to introduce no less than five inclines, on which the full wagons served to draw the empty ones up, and also two inclines worked by two stationary engines of 60 horse power. The line was opened November 18, 1822, which is nearly three years earlier in the present locomotive; but its design, with the exception of the chimney and one or two minor points, has remained unchanged. Although at various times different parts, as they have worn out, have had to be renewed, the new pieces have been made from the same patterns as the old, and some parts of the engine, notably the steam dome, are actual portions of the machine as constructed in 1822. This most interesting relic has lately been withdrawn from service, and it is to find a permanent resting place in the Durham College of Science, Newcastle-on-Tyne.

Another Artificial Camphor.

A few weeks ago the Scientific American published an account of the discovery of a method of making artificial camphor, which attracted no little attention. News now comes from abroad that E. Callemberg, of Lank-on-Rhine, has also succeeded in preparing what he calls artificial camphor. Mr. Callemberg's compound is pure chlorhydrate of terebinth. It is soluble in nitroglycerin, diminishing greatly the maximum temperature reached during explosions, hence it may prove useful in the manufacture of safety explosives. It further lowers the freezing point of nitroglycerin to a very marked degree, a solution containing from the chemical laboratory where the fire was hottest. Officers of the Survey arrived on the scene in time to superintend the removal of these valuable articles to the street.

Smithson's Remains to Be Conveyed to America.

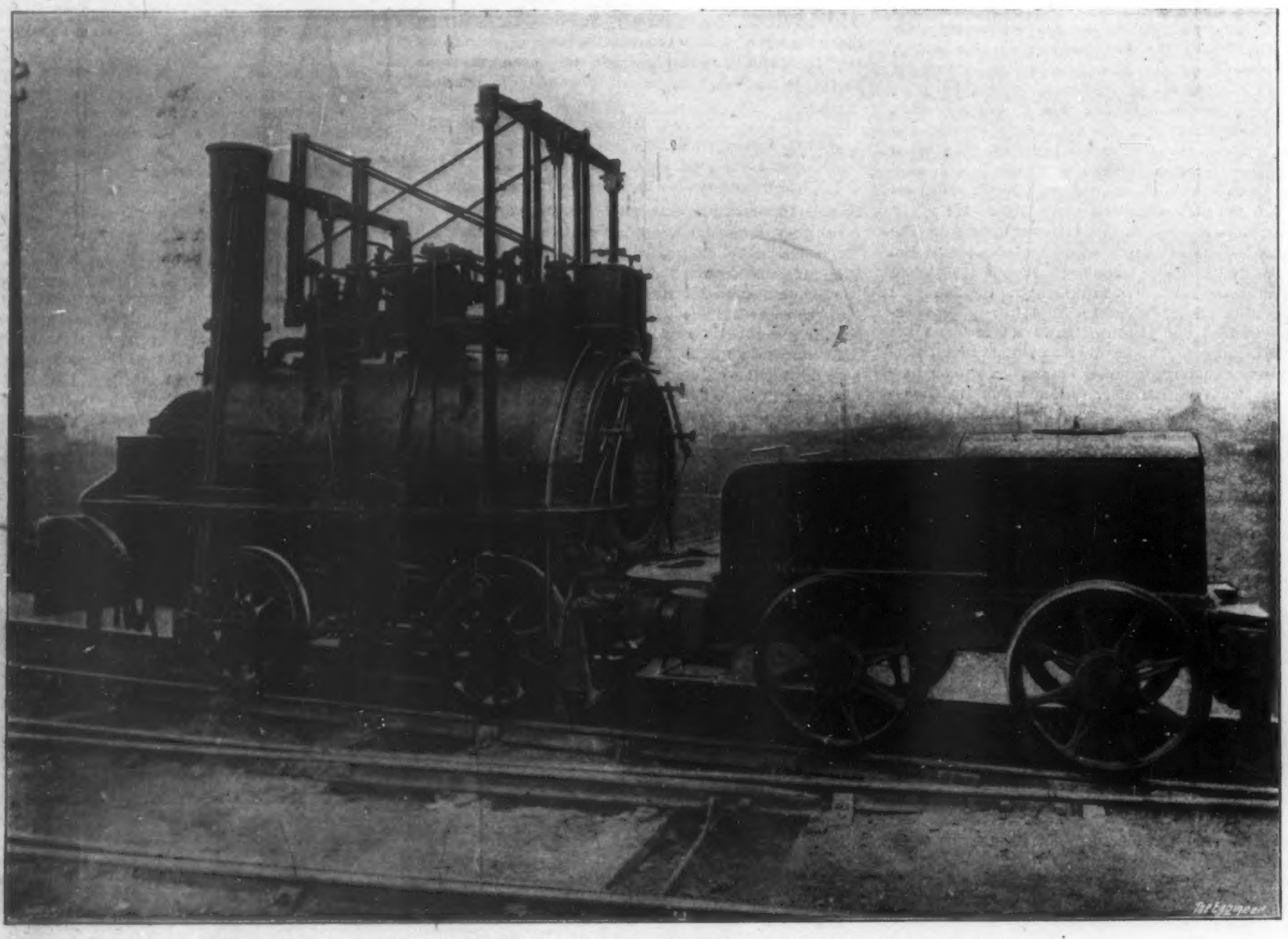
Prof. Alexander Graham Bell has arrived in Genoa. He will convey to the Smithsonian Institution, Washington, D. C., the remains of James Smithson, the founder of the Institution, who died in Genoa in 1829.

Prof. Bell expects to return to Washington from Genoa on January 15.

Prof. Bell offered three years ago to bring the remains of Smithson to Washington at his own expense, and renewed the offer last spring. The action is taken with the sanction and authority of the regents of the Smithsonian Institution. It is expected that there will be no opposition to the removal of the body, as Smithson had but one relative, a nephew, who died many years ago.

The Use of Salicylic Acid as a Preservative in Food.

Macalister and Bradshaw attempt in the London Lancet to refute an error sanctioned by tradition and



Built by George Stephenson in 1822 and only lately removed from service. Cylinders, 10¾ inches diameter by 24 inches stroke. Weight, 15 tons.

THE OLDEST WORKING LOCOMOTIVE IN THE WORLD.

than the opening of the first "public railway," the famous Stockton & Darlington; and on the date named, five of Stephenson's locomotives were in active service. The average speed of the trains was about four miles an hour, and each engine drew a train of seventeen wagons, which weighed in all about 64 tons. As the main interest of this article centers in the longevity of the locomotive we are describing, it is well just here to note that one of the stationary engines at Hetton, which was built in 1822 for hauling the coal wagons up one of the inclines, continued working until 1876, a period of fifty-four years of continuous service.

Our illustration is from a photograph of one of the original Stephenson locomotives, which commenced service on the opening of the Hetton road in 1822, and which after eighty years of unbroken service is still drawing the coal trucks at Hetton, and incidentally maintaining its proud distinction of being the oldest working locomotive in the world. Its dimensions are as follows: Cylinders, 10¾ inches in diameter by 24 inches stroke; diameter of the driving wheels, 3 feet; weight of engine, 15 tons; and haulage capacity, 120 tons at a speed of 10 miles an hour on the level. Of course, it stands to reason that not much of the original material built into it by Stephenson remains

3 to 5 per cent of the chlorhydrate solidifying at 10 deg. to 15 deg. C., the product being a gelatin dynamite of improved quality, while the pure solvent in nitroglycerin dissolves in the cold every kind of gun cotton, including the so-called insoluble varieties. According to La Nature, the chlorhydrate has also proved useful in the manufacture of explosives containing nitrate of ammonia.

Fire in the Geological Survey Building.

On the evening of December 27 the top floor of the building occupied by the United States Geological Survey, Washington, D. C., was practically devastated by fire, although the flames were confined to the chemical and photographic laboratories. Many valuable records, maps, and documents which cannot be replaced were badly damaged by fire and water.

A room next to the photographic laboratory contained more than $30,000 worth of maps recently completed by the Survey. Although the partition of this room was burned, the maps were not injured by fire or water.

The recently completed maps which will be sent to the St. Louis Exposition, and which are worth many thousands of dollars, were in a room directly beneath

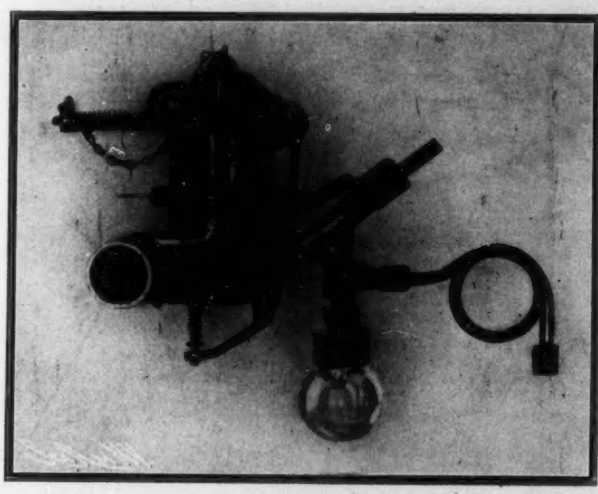
authority, feeling it to be their duty to place on record their conviction that the allegations which have been made against the employment of salicylic acid as a preservative in moderate quantities cannot be maintained, and to challenge the opponents of its use to bring forward a single instance in which it can be shown that bodily injury has resulted from its employment in such a manner. They deny that in the proportion in which they have met with it in articles submitted to them for examination it could be taken by any rational beings to such an extent as to do them any harm whatever. They further maintain that the use of this substance enables manufacturers to place on the market wholesome, agreeable, and inexpensive articles of food which form an acceptable and beneficial variety in the diet of persons who cannot afford more costly luxuries, and which, above all, supply the place of intoxicating drinks. This is the position which they maintain, and state it after mature consideration and with an adequate sense of responsibility.

New York grape growers have two tons of choice grapes in cold storage and will display them in the Palace of Horticulture on the opening of the World's Fair.

THE MANUFACTURE OF AUTOMOBILES.

A FRENCH ironmaster who made a specialty of sea-coast defense guns was once asked where was his plant. "In my laboratory in Paris," he said; and the same may be said of automobile manufacturing. The bicycle, when first introduced in approximately its present form, immediately became so popular that every-one having any species of plant rushed in to participate in the profits. They soon found, however, that they were at the mercy of those possessing automatic machines and jigs for their "parts," and by the time they themselves were fully equipped for making everything required to produce a high-grade machine at low factory costs, the craze was over, and they found themselves with a well-equipped factory for the production of sewing machines or revolvers. The automobile loomed up at about the same time, and offered an opportunity for idle belts to be set in motion. The results have been interesting, and, on the whole, instructive. Some of the machines were ponderous, some too light; some were admirably designed, but they nearly all tended to produce a new type of mechanic—the automobile repairer. Now it would not be fair to say that an automobile never requires repairs, but some require more than others. Even a locomotive has to be cleaned and inspected daily, but the purchasers of machines who were not possessed of a superfluity of mechanical skill wished to get there and back without undue strandings by the wayside. A few manufacturers came out of the ordeal in good form, and with automobiles which have stood the test of time, and we illustrate the two plants of one of them, located respectively at Detroit and Lansing, Mich. The Olds Motor Works had the accumulated experience of years of successful manufacture of gas and gasoline stationary engines to draw upon when they decided to enter the field, which accounts for their early entrance into the business with a full-fledged plant adapted for the needs of the new industry.

It is our intention to deal with a few of the interesting phases connected with the automobile industry as carried out at their plants. It may be said in general that a large part of the plant of a modern factory for the manufacture of automobiles does not differ materially from that which will be found in any well-equipped machine shop adapted to produce "parts" in large quantities; but there are some points of divergence which differentiate these plants from those of others, and the most important is the inspection of materials. The tests of iron and steel are most rigorous. Borings are analyzed and test pieces are shaped and sent to the testing machines at all stages of manufacture. The tests are both mechanical and chemical. There are draw-bar and endurance tests, and no machine leaves the factory without a knowledge that it will perform the work which may reasonably be expected of it. Each machine is tested on the road or a private track, and must be able to climb a thirty per cent grade before being shipped. These tests are of a very scientific nature, those relating to the radiating coils being especially interesting, and being carried on under the direction of a well-known professor of a leading university. When amateurs make their own machines, they usually make an experiment, and the tyro is very apt to buy one. But in the case of the machines to which we refer, the experimental work is all done in a special laboratory, so that the main shops can go ahead and make machines which will run properly after assembling.



The Carbureter.

Assembling the Motors.

The castings are all made at the Lansing plant, where there is a well-equipped foundry and forge shop. The cylinders are cast in one piece, and, after being tested hydraulically, are bored in pairs by special two-spindle boring machines which do the work accurately and at low cost. From the boring machine, the cylinders then go to the hydraulic testing bench, when, if any defect has been discovered, the machined casting is scrapped. If found perfect as to size by gages, it is sent to the stock room, whence it is taken to the fitting and assembling bench, as wanted. The 4-horsepower engine has only one cylinder, and is of the four-cycle type of explosion-motor. There is only one piston rod, one connecting rod and crank, one balance wheel, and two valves, which are connected direct to the shaft. From this, it will be seen that the heart of the carriage is so simple that the liability of a breakdown is minimized. The shaft is forged from a single billet of steel with the aid of a steam hammer, and is accurately machined. The carbureter is a plungerless device which requires no manipulation of air to get a proper mixture. The testing of carbureters is most rigorous, and one of our illustrations shows a gang of them being adjusted. The gasoline tank holds four gallons, sufficient for a hundred-mile run. The water tank for cooling the cylinder is of the same capacity, and does not require to be refilled except at long intervals unless continuous runs are being made, in which case it will require partial refilling every twenty-five or fifty miles, depending on the condition of the roads and the temperature. The radiating coils under the front of the body will keep the water sufficiently cool even on a hot day. Metal wings are secured at short intervals on the coils, serving to largely increase the radiating surfaces. One of our engravings shows the interesting and scientific tests which are carried on relating to the relative efficiencies of various types of coolers.

The products of combustion are allowed to dissipate in the air with the aid of a muffler. A jump spark igniter is used; it is so placed that the mixture entering the cylinder keeps it free from carbon deposit. The time of ignition, so important in all gasoline engines, is regulated by a small lever at the right side of the seat. Two sets of special batteries are used, the life of which is several months, and renewals are easy. If one set of batteries should give out, the other can be brought into play by turning a switch. The motor and its appendages are run for hours in a special room on testing benches. Here they are under the constant supervision of experts; at least four of whom must file a written statement relating to each machine. Having described the engine proper, the running gear and body are next in order. The body is mounted on 28-inch wooden or steel wheels with $2\frac{1}{2}$-inch pneumatic tires. The wheel base is 5 feet, 6 inches, which helps to make steering easy and assists to do away with jars. The body is hung very low (independent of the motor) on rubber cushions, doing away with vibration and insuring safety in making short turns. No reaches are required, as the long-leaf springs that carry the motor and the body extend from the front axle to the casing that incloses the rear axle, thus making a perfectly flexible gear. The front axle is a very heavy steel tube reinforced and having

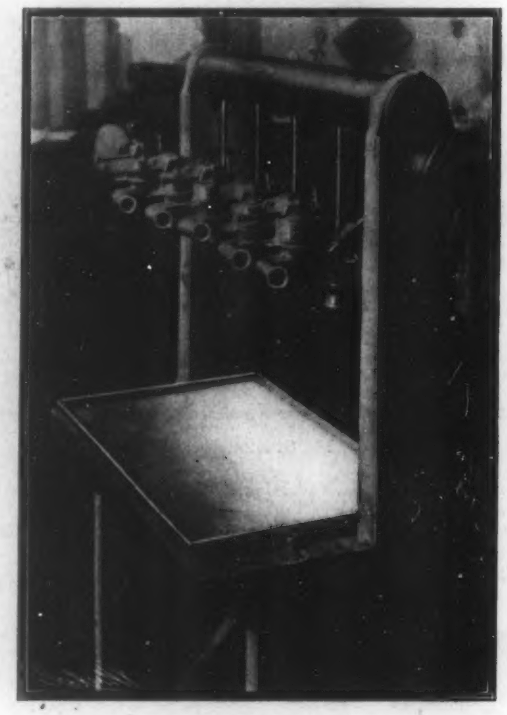
An Automobile See-Saw Showing Capacity for Control.

HOW AMERICAN AUTOMOBILES ARE MADE IN LARGE QUANTITIES.

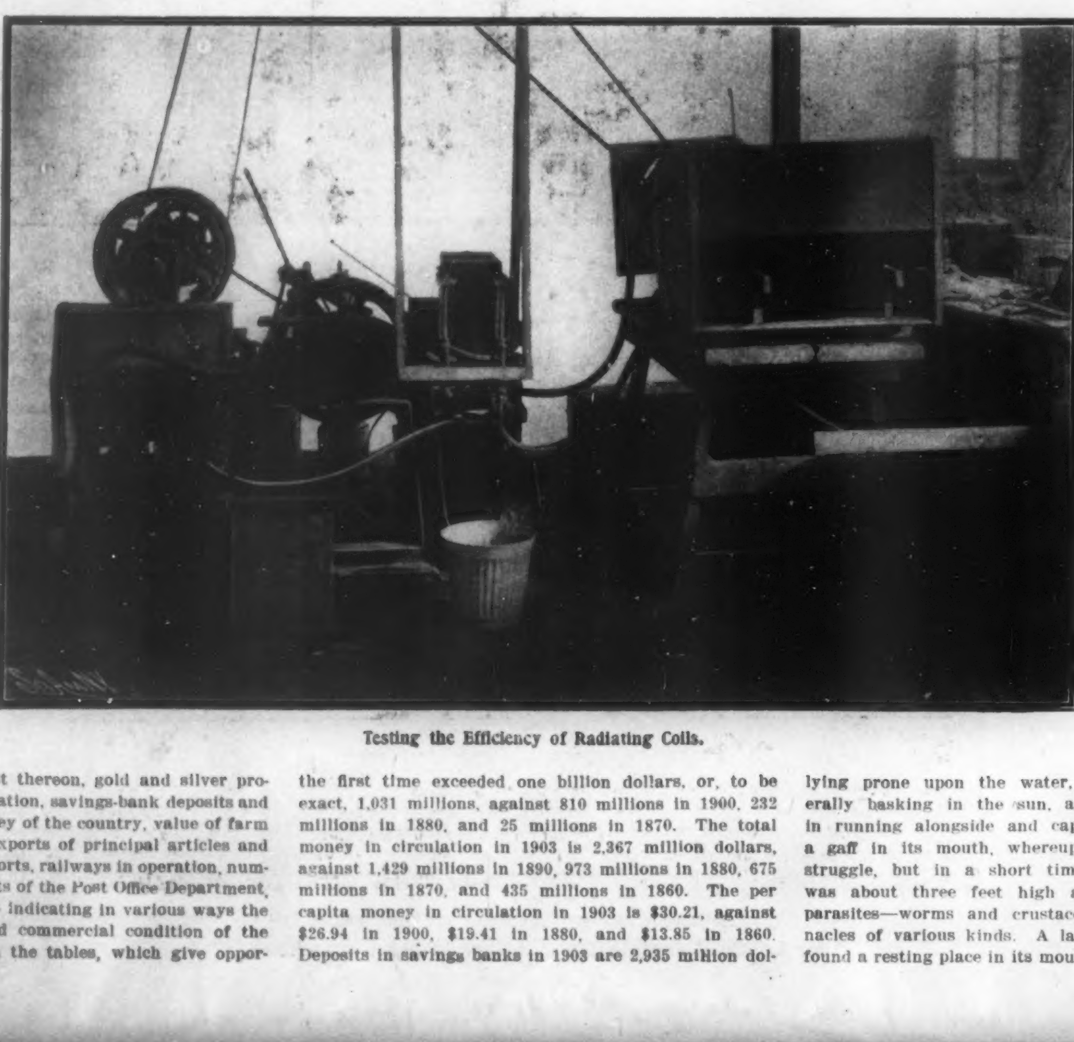
heavy steering knuckles. The rear or driving axle, with the compensating gear near its center, runs on roller bearings in a casing made of heavy steel tubing, and having two heavy oval flanges that screw together securely and form the gear casing. This construction relieves the driving axle and compensating gear of all strains except the driving of the carriage. The rear wheels are keyed fast to the axle. Both front and rear wheels are given additional strength by steel trusses. The steering lever is attached to the body, which is supported at the front by a double elliptic spring that absorbs all vibration from irregularities of the road without affecting the rigidity of the steering mechanism. The power is transmitted direct from the motor shaft to the rear axle by a chain, tested to 4,000 pounds working strength, which effectively disposes of all chain troubles. The transmission gear is protected by a steel case which is oil-tight, thus permitting the gears to run continually in an oil bath. It has three changes—two forward and one reverse. It is very simple and effective, and for ordinary running all the gearing is locked fast to the motor shaft, there being no gears used except in starting, climbing very steep grades, or in running backward. This avoids friction and noise and the general wear and tear usually found in most transmission gears. The compensating gear and rear sprocket are incased and completely protected from sand and mud. The motor is started easily from the seat by means of a non-detachable crank at the right hand of the driver. A turn of the crank will put the motor in action. The speed of the motor is increased by means of a foot lever acting upon a gate-valve opening which admits more explosive mixture to the igniting chamber, and is further increased by advancing the spark controlled by the lever for change of lead. One lever controls all changes of gear, moving forward to get the two speeds ahead, and backward for the reverse, making a simple as well as effective control.

A very effective band brake operated by the foot is applied by a clutch band to a flange attached to the driving sprocket. It is powerful enough to slide the driving wheels. There is also an emergency brake acting directly on the rear axle and shutting off the power, so that the machine can be stopped on an instant's warning.

The range of speed is from three to twenty-five miles an hour, and the net running weight is 870 pounds. When the ease of running and the comfort of traveling in this machine are considered, it is little wonder that they are made in such large quantities as a recent visit to these factories would indicate. The running gear is well adapted to support the covered body of a delivery wagon. We have already illustrated this type of vehicle.



Testing Carbureters.



Testing the Efficiency of Radiating Coils.

Progress of the United States in Its National Industries.

"The Progress of the United States in its Material Industries" is the title of a statistical statement presented by the Department of Commerce and Labor through the annual report of the Chief of the Bureau of Statistics. The table pictures conditions in the great industries and material interests of the United States in 1903, where such figures are available, and compares those conditions with those of earlier years, running back, where possible, to the year 1800.

Area, population, wealth, public debt and the interest thereon, gold and silver production, money in circulation, savings-bank deposits and depositors, value of money of the country, value of farm products, imports and exports of principal articles and total of imports and exports, railways in operation, number of post offices, receipts of the Post Office Department, and many other subjects indicating in various ways the financial, industrial, and commercial condition of the country are included in the tables, which give opportunity to compare present conditions with those of earlier years. In area, for example, the total in 1903 is 3,025,600 square miles, against 2,980,959 square miles in 1850, and 827,844 square miles in 1800. These figures do not include Alaska or the islands belonging to the United States.

The population in 1903 is stated at 80,372,000, against 23,191,876 in 1850 and 5,308,483 in 1800. The wealth of the country is stated at 94 billions of dollars in 1900, and presumably 100 billions would not be an unreasonable estimate for 1903, while for 1850 the wealth of the country stood at 7 billion dollars, no estimate being given for any year earlier than 1850. The per capita wealth is set down at $1,235 in 1900 and $307 in 1850, having thus more than quadrupled meantime. The interest-bearing debt in 1903 is 914 million dollars, against 1,724 millions in 1880 and 2,046 millions in 1870. The per capita indebtedness of the country in 1903 is $11.51, against $60.46 in 1870, and the interest per capita, 32 cents in 1903, against $3.08 in 1870.

Gold and gold certificates in circulation in 1903 for the first time exceeded one billion dollars, or, to be exact, 1,031 millions, against 810 millions in 1900, 232 millions in 1880, and 25 millions in 1870. The total money in circulation in 1903 is 2,367 million dollars, against 1,429 millions in 1890, 973 millions in 1880, 675 millions in 1870, and 435 millions in 1860. The per capita money in circulation in 1903 is $30.21, against $26.94 in 1900, $19.41 in 1880, and $13.85 in 1860. Deposits in savings banks in 1903 are 2,935 million dollars, against 1,524 millions in 1890, 550 millions in 1870, and 149 millions in 1860. The value of manufactures for the census year 1900 is given at 13 billions of dollars, against 5 1-3 billions in 1880, and less than 2 billions in 1860. Railways in operation in 1902 are 203,132 miles, against 166,703 miles in 1890, 93,262 miles in 1880, 52,922 miles in 1870, 30,626 miles in 1860, and 9,021 miles in 1850.

DEEP-SEA SUNFISH

BY PROF. CHARLES F. HOLDER

So remarkable are many of the large fishes recently discovered that it would be difficult to indicate any individual more singular in shape than another; yet in the entire group the sunfish (*Mola*) stands out as perhaps the most curious and impossible among the forms which attain a large size. It is a shapeless creature and seemingly cut off abruptly behind the fins, and apparently a grotesque head, the ears represented by fins.

The sunfish, or head-fish, belongs to the family *Molidæ*. It is fairly common in the vicinity of Santa Catalina Island, off Los Angeles County, California; that is, I recall no locality on the American coast where the sunfish can be so often observed and examined near at hand. In general appearance the fish is oblong and deep; very thin or compressed; cut off (truncate) behind, so there appears to be no tail, a mere rim of movable flesh taking its place, which has a very limited use in the slow locomotion of this extraordinary fish. The skin is hard and coarse, rough, scaleless, and covered with flat spines; the entire skin in the individuals examined by me was covered with a thick coating of slime, which appears to be a world in itself for numerous parasites which prey upon the fish.

The sunfish is seemingly formed on a reversible plan; that is, the casual observer might conceive it swimming on its back just as well as the reverse, as its dorsal and anal fins are alike, large, long, and conspicuous, the back portion joining more or less with the rim of the "tail." The side or pectoral fins are very small for the size of the fish; the eyes small, but conspicuous; gills small; air bladder absent; color light gray, resembling that of the shark. The mouth of the sunfish is ridiculously small for so large a creature, and is armed with solid white porcelain-like teeth, completely joined in each jaw, forming a powerful beak.

There are three well-known genera of the sunfishes and six species. Comparatively little is known regarding their habits. Their young are strange, spine-clad little creatures bearing at first but slight resemblance to the adult, and when first discovered, were supposed to be different fishes and were so described. The sunfish is one of the few fishes of little or no use to man, though I am of the opinion that the hard skin might be utilized. I once learned that the boys of a certain village in Maine were anxious to secure the muscular envelope of a specimen caught by me to use it as rubber. They cut the hard, elastic substance into round shapes and used them for the interior of home-made baseballs, winding them about with yarn. It was the belief of fishermen and boatmen on the New England coast that the sunfish lived on jelly-fishes, and in many specimens examined by me none contained any solid food or traces of it. The first large sunfish observed by me was off Ogunquit, Maine. It was lying prone upon the water, partially exposed, literally basking in the sun, and I had no difficulty in running alongside and capturing it by inserting a gaff in its mouth, whereupon it began a violent struggle, but in a short time gave up. This fish was about three feet high and was covered with parasites—worms and crustaceans, with a few barnacles of various kinds. A large goose barnacle had found a resting place in its mouth, the long "stem" wav-

ing about just avoiding the teeth of the patient sunfish.

I was fortunate in observing a large sunfish in the St. John's River, Florida. I was watching the bar of the river one day when I saw the fish come in and run aground, its long keel striking. In its terror the fish created such a sea that the fishermen went out and captured it, the sunfish proving to be a monster in every sense of the term. On the Pacific Coast I have repeatedly observed sunfishes (*Mola mola*) ranging in size from small individuals weighing from twenty to fifty pounds to huge creatures. A sunfish was taken off Redondo, California, which weighed eight hundred pounds, being over eight feet in length. Another, and perhaps the largest sunfish ever seen, was sighted by an acquaintance of the writer, who approached near enough to put a harpoon into it. The fish slowly sank below the surface, exhausting the rope and taking the bow of the launch down so continuously that the crew were well satisfied when the rope broke. Various estimates were given as to the size of this fish, but all agreed that it must have weighed over a ton. I have frequently observed these fishes near the south end of Santa Catalina, in August, which appears to be a summer meeting and feeding ground for many large fishes. On one occasion in looking over I saw several sunfishes swimming about. They may have weighed forty or more pounds each, and their movements, while slow, were graceful. One was swimming in a circle with a certain dignity, and I could see its peculiar "tail" bend as it turned but a few feet below. The fish had little or no fear of the boat, rising to within a few feet of it—near enough to have allowed the use of the gaff had the crew been so disposed; in fact, nearly all sunfishes caught are taken with gaff hooks which are driven into them from boats, the fishes paying no attention to bait of any kind or dead sardines thrown at them.

The waters of Santa Catalina Island have recently provided, in all probability, the largest sunfish ever taken or perhaps seen. It was literally impossible, even with all the available tackle used in lifting huge tunas and black sea bass, to weigh this fish entire or to lift it entirely from the ground, so that its weight was guessed at a "ton," while conservative estimates placed it at from eighteen to nineteen hundred pounds. The exact weight is not of paramount interest, as the photograph of the fish, herewith shown, proves it to have been a giant of its kind and a capture of great interest. It was 10 feet in length and 10 feet high. While ordinarily the fish is very clumsy, this individual made a fight that will be remembered by the captors, boatmen Farnsworth and Elms, of Avalon. The former discovered the fish while fishing from a launch, and determined to attempt its capture. The fish was swimming about, its huge sharklike fin above the surface; yet the launch was steamed alongside and the boatman thrust a heavy gaff into it. Immediately the fish began a series of elephantine struggles which more than once threatened the boat, and for over an hour the boatman held it, hoping to wear it out. Another launch then came to his rescue, and another gaff was hooked into the fish, which now appeared to renew its struggles, hurling the water over the boats and plunging downward with ponderous strength in a manner that would have deterred some fishermen; but these men held to the fish, and after three hours subdued it and with no little difficulty towed it into port, where it was measured, photographed, and a futile attempt made to weigh it.

THE LARGEST SUNFISH EVER CAUGHT.

Length, 10 feet; height, 10 feet; estimated weight, 1,800 pounds.

HOW A PYTHON EATS.

BY DR. V. BURTI.

Photographing animals is a difficult enough task; but the photographing of snakes is one that requires unusual patience on account of the extreme restlessness of most reptiles. Usually the only successful way in which to keep the snake quiet in front of the camera is to feed it. While eating, most animals, whether they be wild or tame, hold the prey firmly in the throat, totally oblivious to everything about them.

It was thus that the remarkable photographs herewith presented were secured. The reptile pictured is a python twenty feet long, forming part of the collection of the Detroit Scenic Park. Needless to say, not a few plates were ruined before suitable pictures were obtained. After placing the python in a warm room, a rabbit was presented to him. The reptile, having eaten nothing for some days, was only too eager for the prey. A few seconds of freedom had elapsed, and the poor rabbit fell into the coils of the snake, which squeezed him to death and then swallowed him whole. In exactly twelve minutes the hind foot of the rabbit disappeared down the python's throat.

Python and Rabbit Face to Face.

In the Toils.

The Rabbit's Head Disappears.

The Last of the Rabbit.

HOW A PYTHON EATS.

Sense of Smell in Snails.

According to the researches of M. Emile Yung, the sense of smell in the snail seems to be located not only in the feeling organs but all over the body, as experiment proves that the snail can perceive odors by means of sensory cells which are placed in different parts of the body, quite apart from the special organs which might be supposed to be his only means of sensation. The idea of sensory cells of this kind distributed over the body of an animal is an interesting one, and is clearly brought out in M. Yung's experiments, which form the subject of a paper read before the Académie des Sciences. He observes the large snail (*Helix pomatia*) which is common in France. It has been generally admitted since the observations of Moquin-Tandon that the snail has a good sense of smell, and the organ is seated in the terminal button at the end of the large feelers. Hence the term of nasal organ which he gives to the latter, and the expressions olfactory ganglia or rhinophoric, etc., which a number of scientists now use for designating these nerves and ganglia.

The writer explored the body of the Helix with a camel's hair brush dipped in a non-corrosive odorant, such as essence of chamomile. He finds that if the olfactory sensibility exists on the large feelers, it is not localized there exclusively. The small feelers, the under part, and the skin of the back, and in fact the entire surface not covered by the shell, is affected by the odor. The numerous experiments which he made show that the snail is still in the stage of *diffusion* of the olfactory sense, and can in fact smell odors at all parts of his skin, as Cuvier already supposed. The feelers are more sensitive to odors than the back, etc., but contrary to the opinion of Moquin-Tandon, a snail which had its four feelers amputated did not change its manner of living and was able to find its food; it also fled from disagreeable or harmful odors. A microscopic examination of the different nerve cells did not show any reason for giving a special sense to one part of the body to the exclusion of the other. The cells differ from each other by their number only. He considers that the cells are capable of receiving different sensations such as shocks, heat, odors, etc. As to the distance at which the snail can smell odors: He places a dozen or more snails (which have been deprived of food) in a circle, and puts different kinds of food in the center. When the snail perceives the odor, he is attracted toward the middle. In most cases the attraction took place at a small distance, an inch or more. Distances higher than this were obtained only by foods giving a very strong odor; the greatest effect was obtained with very ripe melon. No substance attracted farther than 16 inches.

Francis Snyder, who was the designer and patentee of a large number of toys and similar nursery appliances and who was known as the "Children's Friend," died at his home in New York on September 19, 1903. He was born in France and was sixty-eight years of age. He was at one time interested in politics and was closely associated with the late Ex-President Chester A. Arthur.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

RECEIVER FOR WIRELESS COMMUNICATION.—G. MORIN, Havana, Cuba. Mr. Morin's coherer differs from the ordinary type in being decohered magnetically. The terminals of the coherer extend into the tube from the bottom and are separated by an insulating plate. Iron filings cover the terminals and lying loosely in the tube on these filings is an armature. When the filings are cohered a solenoid surrounding the tube is actuated by the local circuit to energize the armature and lift it away from the terminals, drawing with it the filings which have adhered thereto.

Engineering Improvements.

SPARK ARRESTER AND EXTIN... ISHER.—A. P. ZINK, Lorain, Ohio. The object of the improvement is to provide details of construction for a spark arrester and extinguisher well adapted for coaction with the draft-stack of a locomotive and which will arrest all sparks entering the stack and convey them into a receptacle wherein they are extinguished by water and at intervals are automatically discharged from the receptacle, which when emptied returns to normal position for renewed service.

BACK-PRESSURE RELIEF-VALVE.—C. A. CUNNINGHAM, Brainerd, Minn. In this patent the invention relates to steam engines; and the object is to provide a new and improved back-pressure relief-valve arranged to completely relieve the piston in the steam-cylinder of back pressure, thus insuring a steady running of the engine and utilisation of the motive agent to the fullest extent.

ROTARY ENGINE.—I. V. KETCHAM, New York, N. Y. Mr. Ketcham's invention relates to a mechanical device adapted to be embodied in the construction of rotary engines, pulleys, wheels, rams, and other constructions. The object of the improvement is to provide a compact and simple construction wherein the power may be augmented without a corresponding increase in the pressure of the motive fluid.

LUBRICATING DEVICE FOR HIGH-SPEED AND EXPLOSION MOTORS.—L. RENAULT, Billancourt, Seine, France. The object of this inventor is to obviate many inconveniences in applying lubricants, and to this end he utilises the action of the centrifugal force of the heads of the connecting-rods by collecting in reservoirs placed in a suitable manner above the bearings the oil thrown out from the heads of the rods, the reservoirs serving at the same time as lubricators partly to the bearings, and consequently to these same heads of the rods. The system is applicable to all kinds of motors, but is more particularly adapted to motor-vehicles.

Hardware.

TOOL-HEATING HANDLE.—M. KALARA, New Rochelle, N. Y., and F. GAILER, New York, N. Y. This handle is especially adapted for book-binders' tools, and it is capable of heating the tool continually. This is effected by providing burner devices and supplying gas thereto through a flexible tube. The invention enables the tool to be kept heated continuously, and at a uniform and any desired temperature. It also provides for interchanging the tools at will, so that a single handle will do for any number of tools.

RATCHET-WRENCH.—W. W. MURCH, New York, N. Y. The object of the invention is the provision of an improved ratchet-wrench which is arranged to permit the user to quickly and conveniently screw up or unscrew nuts, bolts, and the like without disengaging the nut or bolt-head during the operations. The wrench will prove very serviceable in places in which but a limited swinging motion can be given to the handle.

BRACE.—A. S. E. METCALF, Moville, Iowa. In this patent the invention relates particularly to improvements in a combined brace, chuck, and wrench, the object of the inventor being the provision of a device of this character having a wide range of adjustment for holding bits and drills and for removing nuts of various sizes.

Machines and Mechanical Devices.

UNIVERSAL SANDING-MACHINE.—A. C. GOUGH, Benton, Ky. The object in view in this invention is the provision of an improved machine which combines the desirable features of prior irregular, drum, and horizontal machines by reason of an adjustment, which may be easily and quickly performed, to bring the grinding element into any one of a number of positions according to the requirements of the work.

BLADE-SHARPENER.—S. R. DUVAL, New Orleans, La. In this instance, the object is to provide a sharpener of a type having coacting grinding, honing, or stropping rollers, whereby both sides of a blade may be operated upon simultaneously, thus quickly bringing the "teeth" or "feather" of a razor-blade edge to a uniform and central line, leaving the blade in condition for use.

Miscellaneous.

BOOK SUPPORT AND CONTAINER.—J. J. KOOSTER, Tiffin, Ohio. In this patent, the object of the invention is to provide a new and improved support and container more especially designed for use in churches, chapels, and other places and arranged to form a resting-desk for a mass-book or the like, and to form a receptacle for containing the book when not in use.

CLASP FOR SHAPING HAT OR BONNET FRAMES.—A. BRODIN, St. Joseph, Mo. The purpose of this improvement is to provide means to enable a milliner to quickly shape a frame of wire as a foundation of a hat to be made of chiffon or other light goods by using a hat formed of felt, straw, or other substantial material that has been pressed into shape on a block, such means consisting of a clasp to be applied in sufficient number for the retention of wire as it is bent into shape over the hat or bonnet body that is to be duplicated in flimsy material.

CANDELABRUM.—W. SCHIMPF, New York, N. Y. This article is especially adapted for table and decorative purposes, and also upon an altar or for other devotional purposes. The candelbra is so constructed that it may be presented in the form of a single light or candlestick or may be provided with arms of any number within the compass of a given circle with or without a central candle-holding cup or candle-support.

MUSIC-LEAF TURNER.—L. POULIN, Butte, Mont. Mr. Poulin's invention has reference to improvements in music-leaf turners, and the object in view is the provision of a simple mechanism by means of which the leaves of music may be readily turned in either direction and not interfere with the playing of a musical instrument.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 4960.—For makers of reversible air motors of ½ to 2 h. p.

Inquiry No. 4961.—For makers of small ice and refrigerating outfits.

Inquiry No. 4962.—For makers of briquette machinery.

Inquiry No. 4963.—For machines for pressing liquid and mud peat.

Inquiry No. 4964.—For manufacturers of looms for weaving rattan.

Inquiry No. 4965.—For manufacturers of core drills.

Inquiry No. 4966.—For the address of the Allen Dense Air Ice Machine Co.

Inquiry No. 4967.—For manufacturers of mica axle grease.

Inquiry No. 4968.—For a butter cutter which cuts about 40 pieces to the pound.

Inquiry No. 4969.—For machinery for making fountain pen holders and feeders of hard rubber.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(9269) R. P. asks. Please inform me through the column of "Answers and Queries" in your valued paper of any solutions of a specific gravity of three times as heavy as water or over and kindly oblige reader. A. A very heavy liquid is prepared by dissolving mercuric iodide in a solution of potassium iodide in water. If the mercuric iodide is not available, it may be prepared by precipitating a strong solution of mercuric chloride with a solution of potassium iodide, avoiding an excess of potassium iodide, since it would dissolve the precipitate. When it has settled decant the liquid and dissolve the precipitate in potassium iodide as before.

(9270) H. H. H. asks: Would you kindly give us information on the following problem: Suppose I have in my hand a military rifle which shoots 30,000 feet per second. I stand on a flat car going at the same rate, viz., 30,000 feet per second, and shoot at a target in the front end of the car. Would the ball strike the target? If so, explain; or if not, explain. A. Your inquiry is constantly reappearing with slight change of form. It was answered in our column of "Notes and Queries" Nos. 8823 and 8862. The answer depends upon the three fundamental laws of motion first stated by Sir Isaac Newton in the seventeenth century and known by his name to the present time. The first law states that "a force produces the same effect whether the body on which it acts is at rest or in motion." For this reason the powder sends the bullet in the case you propose just as if car and gun were at rest. The ball has two motions, one with the car caused by the car, the other caused by the powder which causes it to go along the car and hit the target at the front of the car exactly as if the car had stood still. You could stand in a car and throw a ball from the rear to the front, could you not? Why not be able to shoot a bullet in the same manner?

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending December 29, 1903.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

- Abdominal bandage, C. Babion 748,336
- Advertising paper holder, D. L. Stowe 748,117
- Aerating apparatus, liquid, K. S. Murray .. 748,405
- Air brake system, duplex, W. H. Nightingale 748,302
- Aluminium sulfate, drying, Perry & Schanche 748,525
- Amalgamating machine, Alford & Smythe .. 748,456
- Animal shears, W. M. Cahill 747,478
- Animal trap, B. F. D. Miller 748,201
- Aromatic esters and making same, E. Ritsert 748,101
- Asphalt, stone, etc., manufacture of artificial, C. Rubitschung 748,019
- Atomizer, F. A. Smith 748,227
- Automobile, C. E. Roberts 748,015
- Automobile controlling gear, S. J. Anderson 748,252
- Awning hook, D. W. Carr 748,479
- Bag filler, Heinrich & Probst 748,500
- Bag, etc., handle, Ritter & Halpern 748,012
- Bag holder, W. Lilly 748,387
- Bails to baskets, etc., means for attaching, W. C. Williamson 748,552
- Balance escapement, A. M. Lane 748,290
- Ball. See Lubricating metallic ball.
- Bangle fastening, F. Rabone 748,417
- Barrel washing machines, barrel feeding apparatus for, R. Troehler 748,545
- Bat, T. H. Murnane 748,000
- Bead threading machine, F. Mermet 747,995
- Bearing thermostat, G. A. Wall 748,240
- Bearing, velocipede, E. G. Latta 748,291
- Bearing, wheel, C. T. McCue 748,090
- Bedstead, Argubright & Olson 748,036
- Bedstead, door, H. B. Ruggles 748,563
- Beer cooler, O. F. Hager 748,496
- Belt die for brick machines, etc., endless, A. W. Willett 748,244
- Binder locking device, temporary, H. B. Wilson 748,129
- Block signal system, Wolf & Williams 748,450
- Blower, fan, J. M. Stukes 748,436
- Body brace and truss, combined, S. R. Shepard 748,426
- Boiler furnace, Henry & Dillon 748,374
- Boilers, draft appliance for locomotive, W. B. Warren 748,325
- Boilers, product for prevention of furring in, P. Bez 748,341
- Bolster, J. M. & J. H. Ames 748,332
- Book covering machine, Morton & Sherman .. 747,999
- Book, diagram, M. S. Calcutt 747,936
- Boot and shoe stretcher, B. A. Waggaman .. 748,239
- Bottle, non-refillable, O. C. Berchtold 748,042
- Bottle, non-refillable, E. T. Curran 748,051
- Bottle stopper, A. Buckman 748,161
- Bottle support, nursing, B. E. Ives 747,973
- Bottles, cans, etc., top for tooth powder, H. B. Kent 747,978
- Box, W. B. Brooks, Jr. 747,932
- Box covering machine form block, P. S. Smith 748,022
- Box label and lid holder, E. J. Mitchell 747,997
- Boxes, machine for pressing necks in, P. S. Smith 748,429
- Brake, D. F. Earnest 748,355
- Brake block and shoe, separable, W. D. Sargent 748,220
- Brake head, W. D. Sargent 748,106
- Bread cutter, W. H. Busser 748,344
- Bronzing machine, A. Weber 748,125
- Broom, whisk, H. L. Harris 748,370
- Brush, paint, J. P. Knuehmann 748,193
- Bucket dumping apparatus, H. K. McCaughey 748,558
- Bucket suspension device, J. H. Hayward .. 748,371
- Buckets, suspension device for two rope, H. L. Reynolds 748,419
- Building block molding machine, J. B. Cottom 748,049
- Bullet mold, J. W. Anderson, Jr. 748,400
- Bundle carrier, P. E. Le Fevre 748,293
- Button and tie holder, combined, E. Stempel 748,434
- Button, collar, F. G. Neuberth 748,411
- Button, linen, H. Kirchhoff 748,287
- Cableway, T. S. Miller 748,295
- Calculating and recording machine, C. D. Baird 748,039
- Calculating instrument, H. N. Pierce 748,566
- Calculating machine, H. Kaussen 747,977
- Calculating, printing, or analogous machine attachment, A. R. Boynton 748,158
- Camera shutter, I. M. Macy 747,992
- Can, R. E. Pearce 748,213
- Cans, etc., machine for operating on, C. H. Hanford 748,368
- Candy making apparatus, rock, T. Suzuki .. 748,321
- Candy pulling machine, C. D. Frankinson .. 748,069
- Car bolster, S. P. Bush 747,934
- Car construction, D. C. Courtney 748,166
- Car coupling, G. A. Hermanson 747,971
- Car coupling, P. J. Dugan 748,173
- Car coupling, F. Lehrmann 748,384
- Car door, grain, R. G. Jenckes 748,281
- Car drop doors and operating mechanism, D. C. Courtney 748,165
- Car, dump, J. D. McGrath 748,299
- Car fender, self-adjusting, A. O. Lamson .. 748,195
- Car, railway, C. Vanderbilt 748,030, 748,122
- Car reflector, D. F. Cargill 748,346
- Car, sand, A. F. McConnell 748,210
- Car seat, F. K. Fassett 747,957
- Car, side dumping, R. H. Hornbrook 748,188
- Car switch-operating apparatus, tramway or other, A. King 748,508
- Car wheel, G. S. Kyle 747,983
- Car window lock, C. Graham 748,064
- Carpet sweeper, G. L. Reenstierna 748,560
- Carrier. See Bundle carrier.
- Cash register, T. Carney 748,259, 748,260
- Cash register, J. P. Cleal 748,261
- Cash register, W. H. Muzzy 748,406
- Caster, ball, H. S. Cross 747,947
- Casting, H. H. Franklin 748,061
- Cement shingle, G. C. Zwerk 748,141
- Cement shingles, machine for making, G. C. Zwerk 748,140
- Centrifugal machine, M. H. Barker 748,465
- Charring and dry distillation of organic substances, apparatus for continual, H. C. Aminoff 748,457
- Check perforating and printing machine, G. F. Robertson 748,421
- Chemical mixer, A. G. Stevens 748,319
- Chimney, C. Weber 748,242
- Chlorination barrel, W. J. Armbruster, 748,461, 748,462
- Chuck, drill, W. G. Middleton 748,398
- Churn dasher fan attachment, A. F. Moody 748,203
- Churn operating mechanism, I. W. Beeler 748,155
- Cigar branding machine, I. Liberman 747,990
- Circuit changing apparatus, W. Meyer 748,397
- Cisterns or the like, means for constructing, Skinner & Lindsey 748,224
- Clamp collar, D. M. Lester 748,385
- Clasp for garters, etc., C. E. Schaffner 748,423
- Cleaning machine, D. A. Kennedy 747,980
- Clevises, etc., pin locking machanism for, H. A. Bergom 748,043
- Clipper, hair, J. K. Priest 748,416
- Clock, M. Wortmann 748,250
- Clock striking mechanism, A. C. Schuman .. 748,108
- Closet seat collapsible protecting device, I. Franken 747,969
- Closets, etc., siphon reservoir for toilet, A. M. Morrison 748,401
- Cloth holder, L. S. Winterbotham 748,131
- Coal loading apparatus, C. Allison 748,331
- Cock, safety gas, H. J. Doll 748,487
- Coffee pot, T. B. Ferguson 748,491
- Coffin guide, W. Koeper 748,510
- Coke lorry, G. D. Macdougall 748,390
- Collar fastener, horse, J. R. Rose 748,017
- Comb, Richardson & Wright 748,420
- Compound engine, A. J. Peet 748,559
- Condiment holder, J. B. Williamson 748,329
- Conveyor and elevator, endless, Coffin & Lewis 748,481
- Conveyor controlling system, A. C. Eastwood 748,488
- Cooking attachment, muffler, J. H. Fox 748,493
- Cooking utensils, inner containing vessel for, A. Siebelist 748,316
- Cooler. See Beer cooler.
- Copy holder, Shobert & Reno 748,537
- Copy pad, T. B. Ferguson 748,555
- Couch, J. B. Hardtmann 748,184
- Counting and indicating machine, W. Ackerman 747,922
- Cream separator and churn, combined, J. A. Rosback 748,104
- Crutch, Hammond & Bridgewater 748,068
- Cultivator tooth mounting, F. Bateman 748,466
- Cupboard extension, J. H. Waite 748,446
- Curtain bracket, combination lace and roller, J. Yonker 748,339
- Curtain fixture, A. L. Foy 748,180
- Curtain or awning, J. A. Charlton 748,347
- Curtain pole bracket, Zimmerly & Lindewirth 748,455
- Cutlery polishing machine, W. C. & J. B. Mallinson 748,391
- Dead, preserving the, J. Karwowski 748,284
- Detector bar clip and link, T. G. Stiles 748,229
- Dish washing machine, H. H. Jones 748,077
- Disinfecting apparatus, F. C. Nye 748,413
- Display front for boxes, F. Davis 747,950
- Display holder for ladies' hats, F. P. Rabin 748,008
- Dissolving organic or inorganic substances, apparatus for, C. H. Rider 748,217
- Distilling apparatus, J. Stocker 748,564
- Door and hanger therefor, pocket ball bearing, J. K. Thoma 748,544
- Door opening device, O. M. Edwards 748,178
- Door stop, A. A. Terry 748,543
- Dress clip, T. Morton 748,403
- Driers, filling or emptying apparatus for vacuum, E. Passburg 748,414
- Driving apparatus, A. E. Norris 748,412
- Dye and making same, blue anthraquinone, Hepp & Hartmann 748,375
- Dye, trisazo, Israel & Kothe 748,076
- Eggs, composition of ingredients for improving storage, B. Prikryl 748,099
- Electric circuit regulating device, M. H. Baker 748,144, 748,149
- Electric circuits, constant power factor regulator for, M. H. Baker 748,146
- Electric circuits, regulating, M. H. Baker 748,145, 748,147
- Electric generator for intermittent currents, M. P. Ryder 748,534
- Electric generator, turbine, Porter & Currier 748,215
- Electric meter, L. Gutmann 747,968
- Electric switch, I. G. Waterman 748,123
- Electricity for sectional circuits, bar for collecting, H. Dolter 748,053
- Elevator, A. & T. E. Winiarski 748,449
- Elevator, A. R. Wilfley 748,551
- Elevator signaling apparatus, J. McLean 748,408, 148,409
- Engine cooling apparatus, internal combustion, G. McCadden 748,001
- Engine lubricator filler, steam, A. M. Crowl 748,483
- Engine piston, steam, J. Swan 748,233
- Engines, feeding and igniting device for explosive, W. Remington 748,011
- Evaporative cooler or condenser, W. H. Miller 748,296
- Expansion joint, R. E. Vail 748,546
- Explosion chambers, apparatus for loading, F. Anschutz 748,035
- Explosion chambers, device for cleaning, F. Anschutz 748,034

Explosive engine, H. G. Underwood 748,029
Eyeglasses, J. W. Corley 748,554
Fabrics, machine for shaping and trimming pieces of, H. Bryce 748,476
Fan attachment, G. Donnelly 748,353
Fan, toilet, A. M. Miller 747,996
Fastener, T. Giguere 748,277
Fastening device, W. Kaisling 748,078
Fat-like substance and making same, O. Liebreich 748,511
Faucet, G. A. Soderlund 748,115
Feed cutters, pneumatic conveyor attachment for, L. J. Lee 747,987
Fertilizer distributer, J. & J. D. Boyd 748,343
Fertilizer drill, W. N. White 748,549
File cabinet partition, adjustable, I. H. Athey 748,335
Filter, J. B. Allen 748,251
Filtering system, G. Moore 748,088
Filtering system, water, D. M. Pfautz 748,095
Fire escape, W. R. Smith 748,114
Fire escape, Parvin & Snyder 748,305
Fire escape, C. M. Petersen 748,526
Fire kindler, E. C. Sachse 748,312
Firearm single trigger mechanism, G. C. Cline 748,263
Firearm, tubular magazine, Mason & Burton 748,395
Fireplace, A. W. Hall 748,497
Flash gas burners or lamps, feed device for, Wright & Siddall 748,454
Floor construction, C. A. Balph 748,150
Floor joint, water closet, H. S. Renton 748,418
Fluid pressure, system for controlling, E. D. Priest 748,098
Flushing apparatus, J. H. Byers 748,046
Fly wheel, F. James 748,380
Food product and making same, dry, H. Wintruff 748,249
Fork. See Pitchfork.
Freezing device, milk or other liquid, J. W. MacDonald 748,389
Fuel saving briquet, H. Eggers 748,356
Furnace, W. V. Beasley 748,468
Galvanizing apparatus, metal sheet, E. A. Davies 748,350
Game apparatus, H. K. Leonard 747,989
Game apparatus, M. A. Bean 748,467
Game, indoor, S. B. Monson 748,298
Garbage receptacle, J. Thiele 748,119
Garden implement, R. Twohig 748,439
Garment clasp, C. B. Hoy 748,189
Garment supporter, C. E. Hawkes 748,069
Garment supporter, J. Jenkins 748,282
Gas burner, adjustable, W. E. Guese 748,066
Gas burner, incandescent, T. Gordon 748,364
Gas burner, incandescent, C. A. Bluhm 748,471
Gas burner, safety, A. Dominick 748,170
Gas check, U. G. Densten 748,486
Gas light, incandescent, V. H. Slinack 748,225, 748,226
Gas lighting apparatus, H. Rostin et al. 748,310
Gas or air tubing, attaching socket for, A. W. Nicholls 748,301
Gas producer, J. R. George 747,965
Gas producer system, J. W. Gayner 748,361
Gas retort, W. E. Hartman 748,499
Gate, J. Steinbrecker 748,023
Gate, B. G. Olson 748,092
Gate operating device, R. P. Pierce 748,214
Gear, variable speed transmission, V. G. Apple 748,334
Gearing, variable friction, L. Sanders 748,021
Glass tank furnace, H. L. Dixon 748,169
Glove or mitten, S. Hollenbeck 748,187
Glove turning machine, W. S. Ayres 748,463
Gluing machine, neck, P. S. Smith 748,430
Governor, E. W. Evans 748,357
Governor adjusting mechanism, Skinner & Glenn 748,223
Governor, vapor engine, Buchner & McClure 748,477
Grain drier, J. G. King 748,079
Griddle greaser, C. H. Haight 748,367
Grinding machine, A. A. Baker 747,924
Grinding machine, B. F. Bartrug 748,339
Gun carriage or limber or ammunition car, Dawson & Buckham 748,351
Gun recoil check, Meigs & Stout 748,513
Guns, electric firing gear for breech loading, J. F. Meigs, et al. 748,086
Hair crimper, J. F. Martin 748,393
Hair pin, S. H. Goldberg 748,278
Hair waver, M. S. McIntire 748,407
Hammer, foot power, Baker & Horn 747,925
Harness, breast, S. O. Barden 748,152
Hay loader, R. E. Alger 748,032
Hay loader and stacker, F. L. Doty 748,171
Hay rack and wagon box, combined, I. Williams 748,246
Heating pad, electric, W. Rickards 748,309
Heel attaching device, C. W. Woods 748,452
Hinge, H. Hotz 748,377
Hinge, leaf, W. M. Gamble 747,962
Hoisting and dumping apparatus, combined, W. F. Weber 748,447
Hook. See Awning hook.
Hook provided with counting mechanism, C. A. G. Bremer 748,473
Hopper feed regulator, A. T. Ferrell 748,059
Horse power, J. & C. Vavra 748,443
Hose coupling, W. Koller 748,382
Hose nozzle supporting and guiding device, W. R. Joyner 748,507
Hub, vehicle wheel, E. H. Whiting 748,327
Hydraulic press, J. H. Ferguson 748,358
Hydrocarbon burner, L. A. Eggert 748,269
Ice tool, H. J. Kingsley 747,981
Igniting device, W. Gardner 748,360
Incubator heater and ventilator, O. P. Shoemaker 748,538
Index, card, C. McPike 748,519
Induction coil vibrator, R. Varley 748,442
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Ironwork and preparing same, material for protecting, W. O. Emery 748,270
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Kitchen utensil, W. E. Berry 748,255
Knapsack, hammock, and sleeping bag, convertible, G. Klein 748,288
Knife, T. Wenger 748,547
Knitting machine, G. A. Leighton 747,988
Knitting machine, C. A. Santmyers 748,219
Knob, door, W. Munro 748,404
Lamp cut out, arc, M. H. Baker 748,148
Lamp, electric arc, K. Tornberg 748,121
Lamp for multiple or parallel circuits, electric arc, R. H. Henderson 748,185
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Lamp holder, miner's, J. A. Brown 748,475
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Lamp socket, incandescent electric, C. Bakeley 748,337, 748,338
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Lock, W. K. Kaye 748,285
Log overhead turner, P. Wineman 748,130
Loom filling box stand, J. Trahan 748,438
Loom, kindergarten, M. P. & D. Todd 748,120
Loom let off mechanism, F. Benz, Jr. 748,253
Loom, pile fabric, P. & E. Leroux 748,084
Loom shuttle, Marugg & Ruppert 747,993
Loom shuttle motion, Frank & Benz 748,273
Loom take up, A. F. Caswell 748,262
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Manure from apatite, manufacturing, W. Palmaer 748,523
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Marking machine, Richardson & Wilcox 748,529
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Mechanical movement, S. D. Stevens 748,024
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Meter. See Electric meter.
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Mowing machine, B. Holthaus 748,556
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Mowing machine weed attachment, P. Hanson 747,969
Mucilage or glue containing devices, top for, A. H. Bernard 748,254
Music playing mechanisms, expression indicator for automatic, G. H. Davis 748,266
Musical instrument automatic playing attachment, P. Welin 748,126
Musical instrument mechanical playing attachment, E. D. Ackerman 748,142
Nailing machine, V. Sandahl 748,535
Noise muffler, S. Bouton 748,157
Nut and bolt lock means, W. Lay 747,985
Nut lock, S. C. Ramsey 748,009
Nut, lock, W. C. Swift 748,027
Nut locking means, W. Lay 747,984
Oil burner, E. A. Edwards 748,177
Oil burner, E. Boekenkamp 748,257
Oil burner, J. H. Davis 748,267
Oil burner, McFarlane & Pushaw 748,516
Ore treating mechanism, G. M. Rice 748,528
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Pad holder, J. Powers 748,006
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Photographic mounts, manufacturing, P. J. Stuparich 748,232
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Pin for badges, etc., F. H. Noble 748,303
Pipe bending form, W. Vanderman 748,237
Pipe cutter, B. Colom y Marca 747,942
Pitchfork, L. L. Layne 747,986
Plaiting attachment, skirt, M. M. Merrill 748,396
Plane, matching, A. Mason 748,199
Planter, corn, J. Leyhtwine 748,386
Plow, A. E. Squyars 748,318
Plumb bob, H. J. Wolf 748,132
Pocket knife, M. J. O'Connor 748,521
Pocket, safety, G. L. Estes 748,271
Potato digger, J. E. Baird 748,464
Powder composition, smokeless, H. Maxim 748,200
Powdered material dispenser, W. Q. Gunsen. 748,494
Press for oleaginous substances, Zoder & Hayne 748,138
Press valve operating mechanism, J. M. Stuart 748,231
Printing form, G. E. Pancoast 748,004
Printing machine, H. A. W. Wood 748,133
Printing machine, ticket, E. B. Clark 748,163
Printing mechanism, H. A. W. Wood 748,134
Printing press offset preventing mechanism, H. A. W. Wood 748,135
Printing, stamping, etc., platen press for, E. T. Cleathero 747,939
Propeller, screw, T. H. Eastwood 748,176
Propelling device, boat, J. S. Worcester 748,453
Pulp articles, machine for manufacturing, J. H. Rivers 748,013
Pulp, treating, J. H. Rivers 748,014
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Pump, air, M. E. Harmstead 748,498
Pumps, etc., automatic controller for electric, C. H. Durning 748,354
Puzzle, Willey & Barton 748,245
Rack. See Hay rack.
Rail joint, B. P. Taylor 748,234
Rail joint, J. F. Summit 748,437
Rail joint, J. F. Vilsack 748,444
Railway antispreading means, P. Gavin 747,964
Railway ballast tamping machine, L. R. Moseley 748,089
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Railway tie, G. F. Jencks 748,381
Railway tie, metal and concrete, C. H. Quimby 748,307
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Refrigerating apparatus generator, N. W. Condict 747,943
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Road making machine, R. T. Head 748,372
Roadway, W. Wilson 748,248
Roadways, laying asphalt or bituminous, W. Wilson 748,247
Rod coupling, H. A. Dulinsky 748,056
Rolling machine, tube end, H. Rinne 748,100
Rotary engine, L. J. J. B. Le Rond 748,194
Rotary engine, J. W. Weger 748,243
Rotary engine, F. K. Sturdivant 748,320
Rotary engine, J. Gary 748,495
Rotary engine, W. Olewinski 748,522
Rotary engine, Rowe & Witbeck 748,533
Rotary fluid engine, J. F. Cooley 748,348
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Seal press, F. W. Brooke 748,474
Seam, sheet metal, R. Hawkins 747,970
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Service box cover, H. P. Martin 748,394
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Shade and curtain holder, window, G. Wills 748,128
Shade bracket, M. S. Weaver 748,124

Shaft coupling, D. H. Hendershot 748,373
Shampooing, bib and head rest for, L. Larrimore 748,081
Sharpener, knife, J. R. Hare 748,369
Shears. See Animal shears.
Shoe tongue, J. A. Lyons 748,197
Show case, E. C. Thurnau, reissue 12,188
Sifting machine, flour, Grave & Schaible 748,366
Signaling apparatus, electric, Herzog & Wheeler 748,501, 748,502
Signaling system, W. H. Dammond 747,949
Signature gatherer, MacDowell & Sperling 748,198
Skate, A. P. Draper 748,172
Slack take up mechanism, E. G. Shortt 748,112
Slate, treating and cleaving, W. A. McLaughlin 748,518
Sled, bob, G. Koch 748,194
Smelting furnace, E. Riveroll 748,561
Smoke consuming furnace, C. W. Stanton 748,432
Sole, shoe, T. Fadden 748,490
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Tire, elastic vehicle, E. M. Birdsall 748,256
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Trap. See Animal trap.
Treating tank, C. I. Goessmann 748,181
Trolley, W. J. Rowley 748,422
Trolley, T. F. Varley 748,441
Trolley device, Tisch & Kissinger 748,322
Trolling spoon or spinner, P. Junod 747,976
Truck and bolster, car, R. E. Powers 748,007
Truck bolster, D. C. Courtney 748,167
Tube cleaner, W. Miller 748,206
Tube cleaner, E. John 748,283
Turbine, G. Zahikjanz 748,137
Turbine engine, F. J. MacKenzie 748,294
Turbine motor, B. Stevens 748,228
Turbine, multicellular, Rateau & Sautter 748,216
Turbine wheel, steam, H. Zoelly 748,139
Turn table for cranes or the like, R. Wilke 748,328
Typewriter ribbon reversing mechanism, L. Myers 748,208
Typewriter type bar basket, L. Myers 748,207
Typewriters, etc., copy holder for carriages of, I. H. P. Colleen 748,047
Typewriting machine, C. Gabrielson 748,062
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Sewing machines and accessories, dry-thread, New Home Sewing Machine Co. 41,795
Shoes, leather, Baltimore Boot and Shoe Mfg. Co. 41,743
Soap and soap powder, Davis & Marston.... 41,754
Suspensories, J. U. Adams 41,789
Tobacco for pipes and cigarettes, cut, K. K. General-Direction der Tabak-Regie in Wien. 41,777
Tonics and laxative tablets, Kohna Medicine Co. 41,785
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Typewriter ribbons, R. W. Booth......... 41,735
Watches and parts of watches, Georges Favre-Jacot & Co..... 41,747
Water closets, J. F. Johnston..... 41,793
Waterproof fabrics and articles made therefrom, certain named, H. M. Sawyer & Son 41,736

LABELS.

"Antikolin," for machine, J. W. Hightower. 10,635
"Fast Bind—Fast Find," for velvets and other pile fabrics, L. Whitman & Co.. 10,631
"Florida Water," for Florida water, Manhattan Laboratories 10,634
"Household Enamel," for enamel, J. H. Weber & Co. 10,645
"La Palmera Imperial Prunes," for prunes, J. Gallegos 10,641
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"Manusos High Grade Chocolates and Fruits," for confectionery and fruits, P. J. Manusos 10,639
"Meister Brau," for beer and malt extract, A. Wilmanns 10,638
"Peach Mellow," for a beverage, Blumenthal Bros. 10,637
"Plump's Enterprise Fly Wrapper," for wrapping paper, H. F. Plump.......... 10,632
"Soapex," for washing compound, W. R. Hollingshead Co. 10,642
"Viche-Fiz," for medicine, S. F. Croft.... 10,636
"White's Boro Paper for the Toilet," for toilet paper, C. C. White..... 10,633

PRINTS.

"Graphic Base Ball," for a game, C. E. Varney. 872

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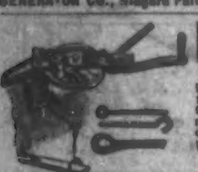

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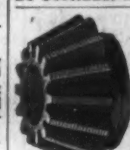

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